CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. • As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	• The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of small-scale project activity

A.1 Title of the small-scale project activity:

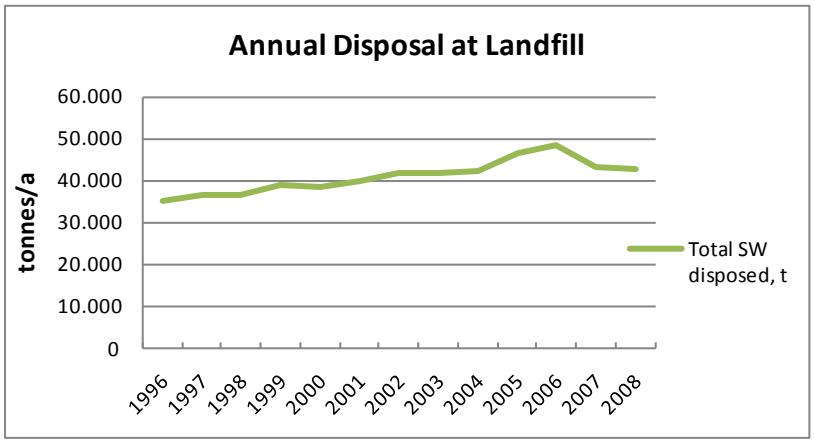
Bolu Landfill Gas to Energy Project, Turkey (hereafter referred to as the "Project")

Version: 3

Date: 04.04.2011

A.2. Description of the small-scale project activity:

The Project is a small scale Landfill Gas ("LFG") to Energy Project, developed by "CEV Marmara Enerji Üretim San.ve Tic. Ltd. Sti." (hereafter referred to as the "Project owner"), which is the regional office of the South Korea-based company CEV Clean Energy & Vehicle. The proposed activity involves the collection and utilization of the LFG with an electricity component with a maximum installed capacity reaching up to 3.3 MW_e depending on the actual gas generation. The location of the proposed activity is the Bolu landfill site, Turkey.



The Project site is the main landfill of the Bolu city with its more than 150,000 inhabitants. It started accepting waste in 1992 and its official operation in 1994. The landfill has two components; an unmanaged dumping area with over 2,000,000 tons of waste and a smaller and more recently built managed landfill site with ca. 150,000 tonnes of waste.

Figure 1. Annual amount of waste disposed at the Bolu Landfill

In 2008, the annual disposed waste amount reached 42,926 tonnes, corresponding to 160-180 t/day on average. The Project aims to make use of the LFG from both areas. Currently, there are 3 venting pipes at the unmanaged dumping area and 5 venting pipes at the managed landfill site. The LFG is freely emitted to the atmosphere and the leachate is being collected and pumped to collection tanks.

On 20.01.2009, the Bolu Municipality opened a tender for managing its solid waste at the landfill site and the Project owner has acquired the right to commercially operate the landfill for 29 years. The Project activity does not only aim at utilizing the already existing waste but it will also make use of the new waste, which will be dumped until 2018. The Project has started with construction on 11/11/2010 and the implementation is expected to start as of 01/06/2011.

The Project activity will be located within the already existing landfill site, where the waste is transported from the city and the leachate is collected and stored. The Municipality has leased the building the landfill site to the Project owner. The Project expansions will also be carried out at this same site. As of time being, some of the operations on the landfill site are being carried out by the Project owner, without a clear binding agreement with the Municipality. These responsibilities could be transferred to the Municipality in the future.

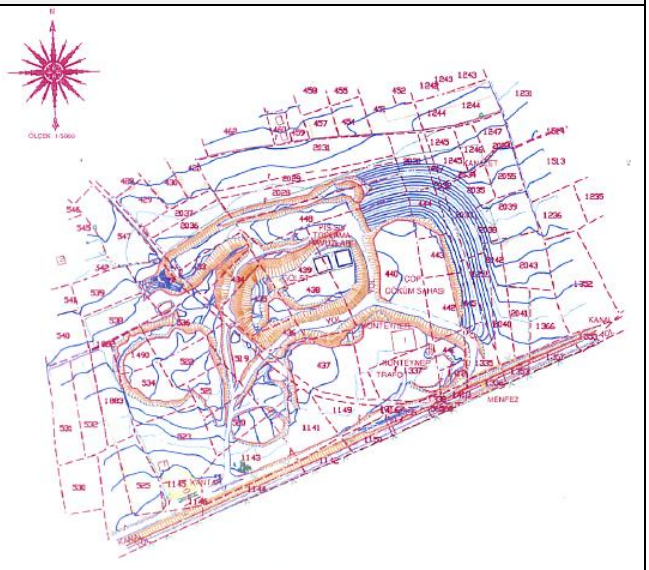
Baseline situation at the site: Prior to the Project, the waste is brought by trucks to the landfill site, weighted at the entrance and afterwards dumped on the landfill site. After a certain period of time, the waste is covered with soil, until which the bad odour creates complaints in the surrounding villages. The leachate is collected and stored in a pond within the landfill site. There is a professional waste picking company on the landfill site. The landfill has a couple of venting points, which have become inoperational because of the higher waste levels or broken venting pipes. There is no flaring or any other form of methane destruction on site.

The proposed Project consists of covering the landfill site with soil, installation of vertical and horizontal pipes for collecting and transporting the recovered LFG, combusting the LFG for electricity generation and flaring the remaining LFG. The Project's objective is to utilize LFG generation from the waste disposed in former years as well as the coming years; therefore the Project covers the Bolu landfill as a complete waste management project.

The purpose of LFG flaring is to dispose of the flammable constituents (particularly methane) safely and to control odour nuisance, health risks and other adverse environmental impacts. The electricity generation will be used to cover the own electricity consumption of the Project and the excess power will be sold to the national electricity grid. The proposed Project will reduce GHG emissions by:

i. Preventing methane emissions to the atmosphere: Municipal waste decays under normal conditions at the landfill site and this leads to the production of large amounts of potent greenhouse gases. Methane is the largest constituent of LFG and its global warming potential (GWP) is 21 times than CO_2. The LFG produced at the landfill site will be captured and destroyed.

ii. The recovered methane will be combusted for power generation. The produced electricity will be supplied to the national power grid and substitute the electricity which otherwise would have been generated by the thermal power plants. Thus, it will reduce the fossil fuel consumption and associated CO_2 emissions indirectly.

Current Landfill	Proposed Project
	

	
Unmanaged dumping area: ca. 150,000 m^2 Managed landfill area: ca. 25,000 m^2	

Figure 2. Visual description of the proposed Project

Figure 3. Current Landfill Site

The expected social and environmental impacts of the proposed Project are:

- It will promote integration of environmental infrastructure (e.g. after-care for landfill sites, etc.)
- The active LFG collection and flaring system will minimize off-site LFG migration and thus prevent potential explosions resulting from subsurface gas migration
- LFG flaring and combusting will dispose of the hazardous constituents safely. At the same time it will reduce odour nuisance and health risks
- It will promote sustainable development by reducing greenhouse gas emissions and their impact on climate change
- Being a model for LFG management with an incorporated clean energy component, it will present an demonstrative example as a multi-purpose solution for effective and sustainable waste management
- It will promote energy security from local sources and contribute to a more sustainable energy infrastructure.
- It will result in creation of new jobs in the regions and transfer of innovative technology to the host country.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host	Private and/or public entity(ies) project participants (*)	Kindly indicate if the Party involved wishes to

Party)	(as applicable)	be considered as project participant (Yes/No)
Turkey (host)	CEV Marmara Enerji Üretim San. ve Tic. Ltd. Sti. (private entity)	No
Turkey (host)	Mavi Consultants (private entity)	No

CEV Marmara Enerji Üretim San. ve Tic. Ltd. Sti. (private entity) is the project owner and shall be defined as the project participant. Mavi Consultants act as carbon consultants for the Project. Contact details are provided in Annex 1.

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

The Project is located in Turkey.

A.4.1.1. Host Party(ies):

The host country is Turkey. Turkey has recently ratified the Kyoto Protocol and is an official member as of August 26th, 2009. Turkey has no emission reduction targets under the Kyoto Protocol and cannot host CDM or JI projects either. There is no limitation for Turkey for hosting voluntary emission reduction projects.

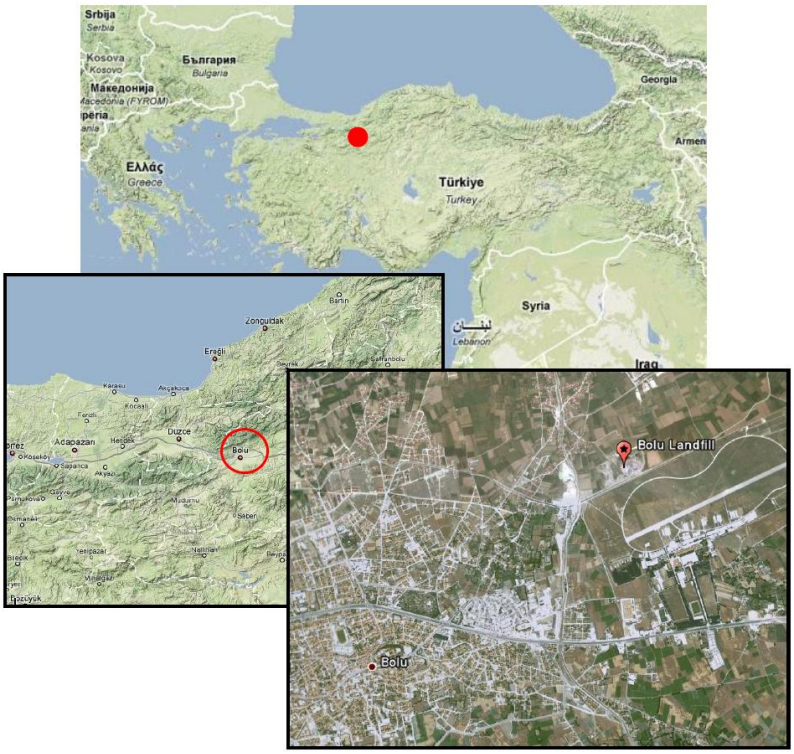
A.4.1.2. Region/State/Province etc.:

Black Sea Region, Bolu province.

A.4.1.3. City/Town/Community etc:

The Project is located in the vicinity of Yukarısoku village, Center district, Bolu city. It is approximately 3 km north east of Bolu city centre and 1.5 km south of the main Anatolian highway.

A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity :



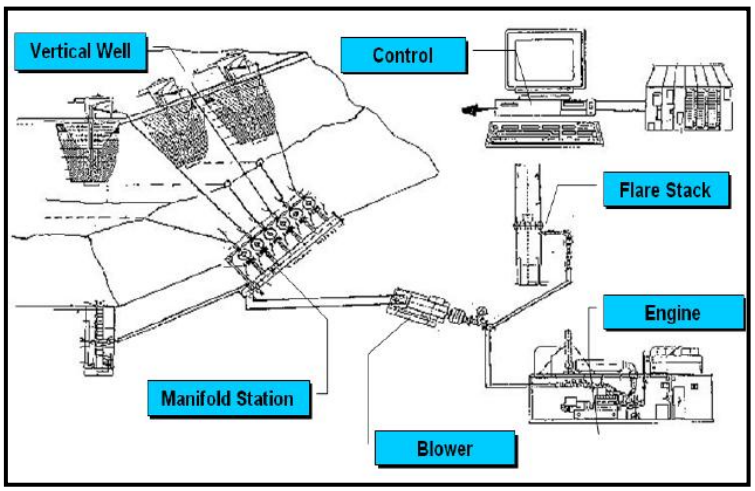
Approximate GPS Coordinates of the Project are:

- 40° 45' 8" N
- 31° 38' 28" E

A.4.2. Type and category(ies) and technology/measure of the small-scale project activity:

The Project is categorized as:

- Sectoral Category 13, Waste Handling and Disposal; and
- Sectoral Category 1, Energy Industries (Renewable- /non-renewable sources)



The Project mainly consists of the following components: Landfill cover, LFG collection system, flare, electricity generation unit and other controlling / measurement equipment.

Figure 4. Concept Diagram of the Project

The indicative Project design is visualized below;

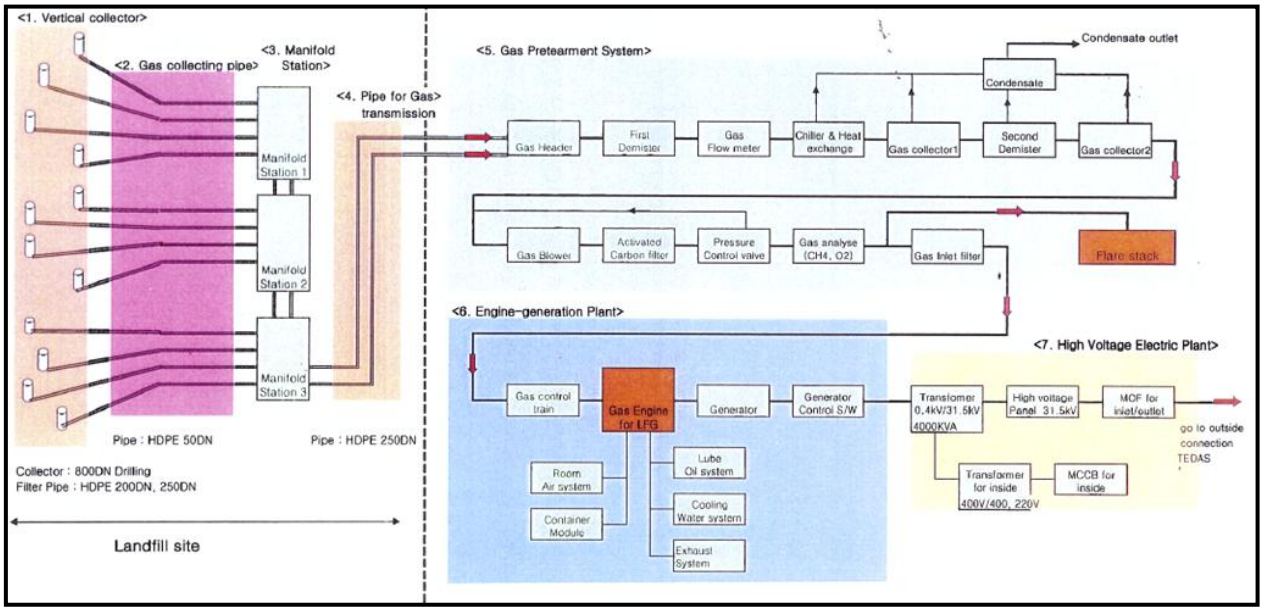


Figure 5. Project Design Overview

Landfill Cover:

The waste will be covered with soil to block methane emissions to the atmosphere to provide sufficient containment and prevent air or rainwater to get into the waste. This cover will include clay, sand and soil layers for erosion control and plant growth.

LFG Collection:

The Project aims at efficiently collecting LFG generated at the landfill site by using vertical wells, which are easy to maintain. The technical properties of this system are as follows;

- Considering the inclination and landfill depth, there will be several units of vertical gas wells covering the landfill.
- The gas will go through: Vertical collection well → Horizontal collection pipe → Manifold Station →Connecting pipe → Header pipe → Pre-treatment facility
- A modular piping network will connect groups of gas wells to a couple of manifolds. The manifolds are connected to the main pipe which delivers the gas to the extraction plant and the flare, and have the following properties:
- The manifold station will control collection pressure, flow rate and properties of each vertical well, prevent condensation in pipes and keeps balance of pressure between individual pipes with automatic gas pressure control valves.
- The condensate in the horizontal LFG collection lines will be returned to the landfill by collecting condensates at dewatering traps at lower points of the LFG collection system.

The LFG will be drawn from the landfill with the help of one or more blower(s) and delivered to the flare or electricity generation unit. The system will be operated at a pressure slightly lower than the atmospheric pressure.

Electricity Generation:

The Project will generate electricity from LFG to cover its own electricity consumption and to feed the rest to the national power grid. The Project will employ up to 3 gas engine generators with 1.1 MW_e capacity each. The Project will use a currently unused building at the landfill site for administrative activities. Electricity will be generated in container type engine generation system and transmitted to national grid after being consumed within the site. Each engine/alternator unit will contain a transformer, switch gear, synchronization system and system protection device. The mechanical energy will be converted into electrical power.

There will be an electrical sub-station constructed that will contain all suitable switching gear and metering equipment to facilitate a proper connection to the national grid network. Parallel to the gas production rate, each of the engine/alternator units will be operated depending on the need. All engine units will be fitted with an internet-based remote monitoring and controlling feature which allows engines to be monitored, started and stopped remotely to be used for emergency cases or maintenance purposes. Regardless of this system, the Project will employ full time staff for operation, routine servicing and repairs.

Flare

In addition to the power generation equipment, the Project owner will install a flare. This will ensure that the LFG, which could not be combusted in the power generation units, will be destroyed safely. Enclosed stacks provide conditions for high temperature combustion to effectively destroy methane with other combustible LFG components and end up with low GHG emissions.

Project Instrumentation

The Project will include sophisticated instrumentation that will allow for the accurate measurement of captured and destroyed LFG, including the following components:

Flow meters will be installed to measure and monitor accurately the flow of the LFG through the system. The measurement points will be: the main delivery pipe, the pipe going to the flare and the pipes going to each of the generation units. These flow meters will also be able to accurately measure various parameters such as pressure, temperature and the gas contents (e.g. methane, carbon dioxide and oxygen). The measurement sampling intervals of the flow meters will be in agreement with the UNFCCC requirements.

The measurement system will be able to store the measured data electronically. The control and monitoring system will allow these readings to be obtained remotely. The flare will include flame and temperature control. Ultraviolet cameras will monitor the presence of the flame and thermocouples will monitor both the temperature of the flame and temperature of the exhaust gas in the stack. This way, the temperature of the stack gas will be regulated with an automated air louver.

A.4.3 Estimated amount of emission reductions over the chosen crediting period:

The Project is expected to achieve the following emission reductions:

Table 1. Expected Emission Reductions of the Project

Year	Ex-ante estimation of emission reduction in tCO2e
2011 (partial)	13,637

2012	23,475
2013	23,773
2014	24,049
2015	24,305
2016	24,543
2017	24,764
2018 (partial)	14,483
Total estimated reductions, tCO2e	**173,029**
Total number of crediting years	**7**
Annual average over the crediting period of estimated reductions (tonnes of CO2 e)	**24,718**

A.4.4. Public funding of the small-scale project activity:

The Project will not receive any ODA finance. Please see Annex 2 for further details.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

There is no registered small-scale CDM project activity or a request for registration for another small scale project activity:

i. By the same project participants; and

ii. In the same project category and technology/measure; and

iii. Registered within the previous 2 years; and

iv. Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

This small scale Project Activity is *not* a debundled component of a large scale project activity.

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

For the emission reductions stemming from LFG capture, the small scale methodology AMS-III.G. v.6, "Landfill Methane Recovery", hereinafter referred to as the methodology, is used. The methodology refers to the following tools:

- "Tool for the demonstration and assessment of additionality"; v.5.2 ("Additionality Tool")
- "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"; v.4
- "Tool to determine project emissions from flaring gases containing methane"; EB28, Annex 13

For the emission reductions stemming from electricity generation, the ACM0002 v.12.1 "Consolidated baseline methodology for grid-connected electricity generation from renewable sources is used. This methodology refers to the following tool:

- "Tool to calculate the emission factor for an electricity system", v.2

B.2 Justification of the choice of the project category:

AMS-III.G Applicability:

This methodology is applicable to the Project Activity because;

- This Project will capture and combust methane from landfills used for disposal of residues from human activities including municipal, industrial, and other solid wastes containing biodegradable organic matter;
- This Project involves electrical energy generation directly and this electricity generation component of the Project activity uses a corresponding category (see below);
- The Project results in aggregate emission reductions of less than or equal to 60 kt CO_2 equivalent annually from all type III components.

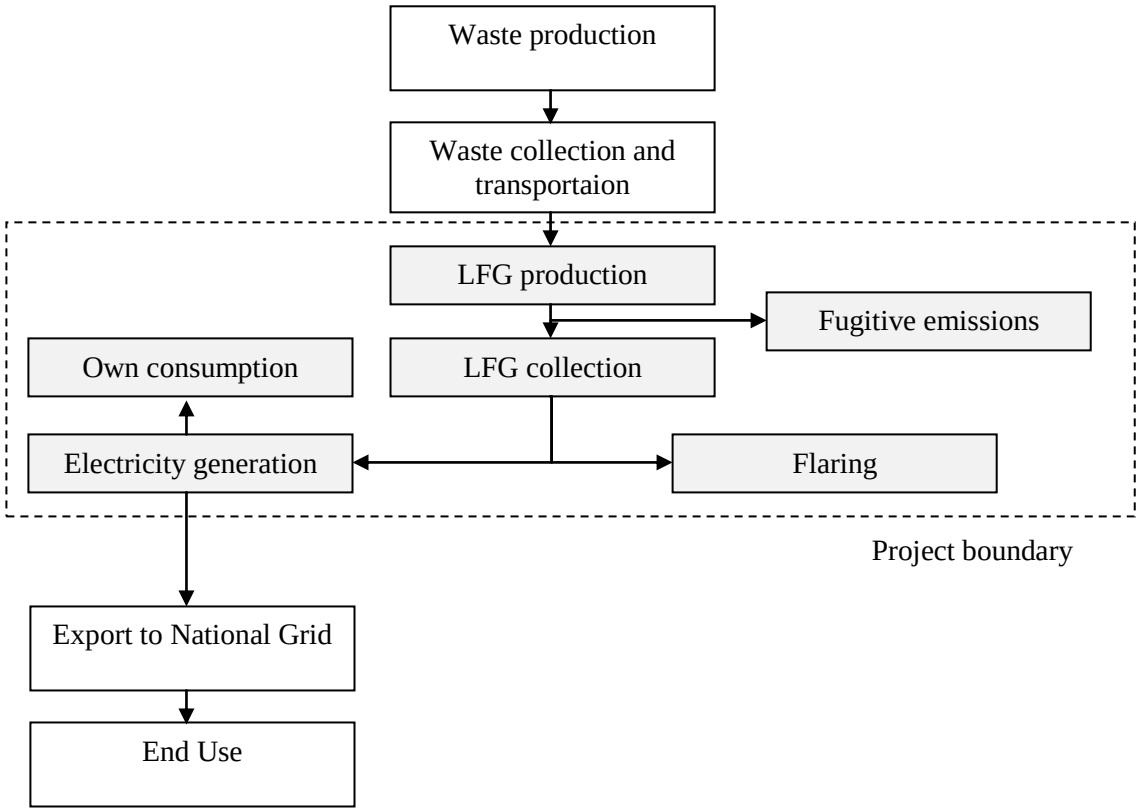
ACM0002 Applicability:

The small scale AMS I.D methodology can be applied if the Project has a maximum capacity of 15 MW_e. The Project will have a total capacity up to 3.3 MW and is therefore eligible for the use of AMS I.D. However, for the sake of conservative approach, the large scale methodology is preferred. Using ACM0002 ensures that the emission factor is calculated in a way that prevents overestimation of the emission reductions of the Project.

B.3. Description of the project boundary:

According to AMS-III.G, the project boundary is the physical, geographical site of the landfill where the gas is captured and destroyed/used. According to ACM0002, the project boundary should encompass the physical, geographical site of the renewable generation source.

Taking both boundary definitions into account, the boundaries of the Project is as follows;



The spatial extent of the Project boundary is defined as the Project site and the plants connected to the grid system to which the Project will be connected to.

Table 2. Sources and gases included in the project boundary

	Source	Gas	Included?	Justification / Explanation
Baseline	LFG emissions from waste degradation	CO_2	No	It is part of the natural carbon cycle, where the carbon was previously sequestered from the atmosphere.
		CH_4	Yes	Main source of emissions.
		N_2O	No	N/A
	Emissions from the power grid	CO_2	Yes	Main source of emissions.
		CH_4	No	N/A
		N_2O	No	N/A
Project Activity	LFG capture and flaring	CO_2	No	It is part of the natural carbon cycle, where the carbon was previously sequestered from the atmosphere.
		CH_4	Yes	When flare does not operate, methane emissions are subtracted.
		N_2O	No	N/A
	LFG combustion for power generation	CO_2	No	It is part of the natural carbon cycle, where the carbon was previously sequestered from the atmosphere. Only the net electricity generation will be accounted for ER calculations.

		CH_4	Yes	When generator does not operate, methane emissions are subtracted.
		N_2O	No	N/A
	On-site electricity	CO_2	Yes	Project's own emissions are subtracted.
		CH_4	No	N/A
		N_2O	No	N/A

B.4. Description of baseline and its development:

According to AMS-III.G, the baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter are left to decay within the project boundary and methane is emitted to the atmosphere. Baseline emissions shall exclude methane emissions that would have to be removed to comply with national or local safety requirement or legal regulations;

The Project includes the LFG and electricity generation components; therefore different alternatives to these two components will be described;

Alternatives to Landfill Gas Component	Alternatives to Power Generation Component
LFG1: The Project activity (capture of landfill gas and its flaring) undertaken without being registered as a VER project activity.	P1: Power generated from landfill gas undertaken without being registered as VER project activity.
LFG2: Atmospheric release of the landfill gas.	P2: Existing and/or new grid-connected power plants.
LFG3: The Project activity is realized using the VER revenues.	P3: The Project activity is realized using the VER revenues.

There is no incentive to utilise the LFG to produce thermal energy, since there is no demand for thermal energy in the surroundings of the Project site. The Project is a green field investment, which does not modify or retrofit any existing facility. There is no national regulation which would enforce the recovery or flaring of the LFG emitted from landfill sites. Based on the barrier and investment analyses, it is clear that the P1 and LFG1 scenarios are not feasible for the Project owner and are therefore not applicable. The Project being a voluntary initiative, the only plausible baseline scenario would be:

- P2: Generation of grid-connected power, which would have otherwise been generated by the operation of already existing grid-connected power plants and by the addition of new generation sources; and,
- LFG2: Maintaining the status quo, where LFG is emitted into the atmosphere without conducting any management, collection or utilization on the landfill site.

The Project owner does not have other fossil fuel fired power plants or control over the emissions stemming from the baseline scenario. The Project will partially reduce LFG emissions from the landfill and substitute the electricity generation from grid-connected fossil fuel fired thermal power plants, thereby reducing the overall greenhouse gas emissions.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

This section utilizes the "Tool for the demonstration and assessment of additionality" to define alternative scenarios by taking relevant policies and regulations related to the management of landfill sites into account.

Step 1: Identification of alternatives to the project activity consistent with current laws and regulations

Realistic and credible alternatives to the project activity(s) are defined through the following Sub-steps;

Sub-step 1a: Define alternatives to the project activity:

The following realistic and credible alternatives are identified that are available to the project participants or similar project developers that provide outputs or services comparable with the proposed Project activity;

Alternatives to the **Landfill Gas Component**:

- **LFG1**: The Project activity (capture of landfill gas and its destruction) undertaken without being registered as a VER project activity. This scenario assumes that the Project owner will realize the Project activity even in the lack of revenues stemming from Project's emission reductions. In this scenario, the Project would operate a LFG facility which would capture and reduce methane emissions from the landfill site, without any carbon credits. The inclusion of this scenario is required under ACM0001.
- **LFG2:** Atmospheric release of the landfill gas. This scenario corresponds to the current practice on the landfill site by maintaining the status quo, where methane is directly emitted to the atmosphere, without any type of recovery, processing or destruction. The inclusion of this scenario is required under ACM0001.
- **LFG3**: The Project activity is realized using the carbon credit revenues. This scenario corresponds to the Project activity, where the Project only becomes feasible with the use of carbon credits. Under this alternative, the Project will partially capture the LFG emissions from the landfill site and use it for power generation. The rest will be flared in order to minimize GHG emissions and safety risks, which were constitutes the scenario LFG2.

Alternatives to the **Power Generation Component**:

- **P1**: Power generated from landfill gas undertaken without being registered as VER project activity. This scenario assumes that the Project owner would realize the Project activity even in the lack of carbon credits and generate power from the collected LFG in order to feed it to the national grid. The inclusion of this scenario is required under ACM0001.
- **P2**: Existing and/or new grid-connected power plants. This scenario corresponds to the current practice for electricity generation by maintaining the status quo. Under this scenario, the Project will not be undertaken, the existing and new power plants will generate all the power and the national electricity will remain unaffected. The inclusion of this scenario is required under ACM0001.

- **P3**: The Project activity is realized with carbon credits. This scenario corresponds to the Project activity, where the Project only becomes feasible with the use of carbon credits. Under this alternative, the Project will generate power and feed it to the national grid, thereby replacing electricity partially generated by thermal power plants.

The alternative scenario is defined as the combination of both Landfill Gas and Power Generation components, since the Project has both components. Realistic and credible alternative scenarios to the Project activity are identified and Sub-step 1a is completed.

Sub-step 1b: Consistency with mandatory laws and regulations:

For the electricity generation component, the following laws and regulations apply;

Table 3. Laws and Regulations Applicable in the Electricity Market[1]

Legal Framework Concerning Electricity Generation
Electricity Market Balancing and Settlement Regulation • The repealed Electricity Market Balancing And Settlement Regulation published in the Official Gazette No. 25632 dated 03/11/2004
Regulation Concerning Electricity Demand Forecast
Communiqué Regarding Connection to and Use of Transmission and Distribution Systems in the Electricity Market
Communiqué Regarding Preparation of Retail Contract in The Electricity Market
Communiqué Concerning Principles and Procedures for Selection in the Existence of More Than One Application for Generation of Electricity from the Same Source and on the Same Region
Communiqué Regarding Regulation of Market Management Revenue
Regulation on Principles and Procedures for Granting Guarantee of Origin
Electricity Transmission System Supply Reliablity and Quality Regulation
Electricity Market Grid Regulation
Communiqué Regarding The Principles and Procedures of Financial Settlement In The Electricity Market
Electricity Market Import and Export Regulation
Communiqué Regarding Regulatory Accounting Guidelines
Electricity Market Distribution Regulation
Communiqué Regarding the Meters to be used in the Electricity Market
Communiqué Regarding Wind and Solar Measurements
Electricity Market Customer Services Regulation
Electricity Market Eligible Consumer Regulation
Electricity Market License Fees
Electricity Market Tariffs Regulation
Electricity Market Licensing Regulation
Electricity Market Law
Other relevant laws:
Law on Utilization of Renewable Energy Resources for the Purpose of Generating Electricity Energy (Nr. 5346)
Energy Efficiency Law (Nr. 5627)

[1] Source: Energy Market Regulatory Authority (http://www.epdk.gov.tr/english/regulations/electricity.htm)

Forest Law (Nr. 6831)

For the landfill gas component, the following laws and regulations may apply;

Table 4. Laws and Regulations governing the landfill gas component

Legal Framework Concerning the Environment	
The Environment Law	Packaging Waste Control Regulation
Air Quality Control Regulation	Soil Protection Law
Noise Control Regulation	Air Pollution from Heating Regulation
Water Pollution Control Regulation	Hazardous Chemicals Regulation
Control of Solid Waste Regulation	Waste Batteries Regulation
Environmental Impact Assessment Regulation	Soil Pollution Control Regulation
Medical Waste Regulation	Air Pollution from Vehicles Regulation
Toxic Chemical Substance and Prod Regulation	Medical Waste Control Regulation
Hazardous Waste Regulation	Water Resources Protection from Hazardous Materials Regulation
Waste Oils Control Regulation	Urban Waste Water Treatment Regulation
Industrial Air Pollution Control Regulation	Drinking Water Quality Regulation

The Environment Law[2] does not require a tipping fee for accepting municipal solid waste at the sanitary solid waste disposal sites. There is an "environment tax" and another "waste water surcharge" collected by municipalities from households for waste management activities. The collected taxes are mostly used for activities regarding maintenance of city parks and gardens and management of solid waste. Municipalities in the host country mostly lack the funds necessary for environmental activities such as proper waste collection and dumping and they are not familiar with additional costs of sustainable waste management. Therefore, waste management is one of the everlasting problems of municipalities and is an unattractive field for private companies.

According to legal framework, the Bolu Municipality is responsible for the collection, management and proper disposal of municipal waste and shall build and operate the necessary facilities or let 3rd parties do so. Municipalities are not inclined to pay disposal fees to private companies for waste management, which is one of the main reasons private investments in this field have been very limited in solid waste management. Under these circumstances, the Municipality has organized a tender and the Project owner has won it by offering landfill site management with no cost to the Municipality.

The Project is a voluntary investment managed by a special contract between the Bolu Municipality and the Project owner. Therefore the Project has to be in compliance with all relevant legislation. The Project is licensed and permitted by public authorities. All scenarios described above are valid according to national laws, regulations and communiqués.

For scenario LFG2, the most relevant regulation governing landfill sites is the "Control of Solid Waste Regulation", which describes the control of LFG emissions in its Article 27. Accordingly, landfill sites are *not* required to capture and/or to destroy LFG emissions. This regulation does not set any obligations or penalties but only suggests the reduction of GHG emissions. Therefore, this alternative reflects current

[2] The Environmental Law (Nr. 2872), dated to 11.08.1983 is a comprehensive law describing relevant public bodies and their responsibilities, principles of environmental protection, limitations and prohibitions, penalties etc. It is also supported by various specific communiquees and regulations.

practice and is in agreement with current laws and regulations. However, this scenario does not only create odour problems, it poses some safety risks as well.

For scenario P2, maintaining the status quo, without the realization of the Project activity, is by definition in agreement with the relevant legislation.

As a result, these alternative scenarios to the Project activity are realistic, credible and in compliance with mandatory legislation and regulations.

Step 2: Investment analysis

According to the Additionality Tool, this step involves the determination whether the proposed Project activity is not:

(a) The most economically or financially attractive; or
(b) Economically or financially feasible, without the revenue from the sale of emission reductions.

Sub-step 2a: Determine appropriate analysis method

According to the Additionality Tool, one of three options must selected:

i. Simple cost analysis (where no benefits other than CDM income exist for the project)
ii. Investment comparison analysis (where comparable alternatives to the project exist)
iii. Benchmark analysis

Because the Project will receive revenues from the sales of electricity, and since there are no comparable investment alternatives to the proposed Project, option (iii) benchmark analysis is selected. In this case, the most likely alternative to the Project would be simply not to install flaring and generation equipment on the landfill site.
The Project's investment analysis is based on the capacity of 1.1 MW, as a detailed study on expansion costs are unavailable in the feasibility study.

Sub-step 2b: Option III. Apply benchmark analysis

The likelihood of the development of this Project will be determined by analyzing its **Project IRR** based on the scenarios with and without the sales of carbon credits.

IRR is a measure of investment profitability. According to the Additionality Tool, the assessment of the financial performance of the Project with and without carbon revenues shall be carried out according to benchmarks. The chosen benchmark for the Project is the discount rate. This means that the Project would be attractive only if the IRR exceeds the discount rate. The "Guidelines on the Assessment of Investment Analysis" v.3, EB51 ("Guidelines") suggest that the IRR shall be calculated without considering financial expenses such as principal and interest payments. This means that the "Project IRR" shall be calculated.

Explanations to the calculation methodology:

Guidance[3] Nr.	Guidance	Calculation procedure implemented	Conclusion
3	"The period of assessment should not be limited to the proposed crediting period of the CDM project activity. ... In general a minimum period of 10 years and a maximum of 20 years will be appropriate."	The actual project activity is not limited in time to the crediting period being requested. The Project has a crediting period of 7 years. Therefore, in agreement with the UNFCCC guidance, a longer investment analysis period shall be selected, which is chosen to be 15 years.	Satisfied
5	"Depreciation, and other non-cash items related to the project activity, which have been deducted in estimating gross profits on which tax is calculated, should be added back to net profits for the purpose of calculating the financial indicator"	The calculations do not consider non-cash items (e.g. depreciation, interest expenses etc.). They are included in the financial model of the project only for informational purposes and do not affect the financial indicators. The IRR calculations and their assessment are made with a pre-tax approach.	Satisfied
9	"The cost of financing expenditures (i.e. loan repayments and interest) should not be included in the calculation of project IRR."	Interest and principal repayments are included in the financial model only for informational purposes. They do not affect the financial indicators. The IRR is calculated without taking interest expenses into account.	Satisfied
11	"Due to the impact of loan interest on income tax calculations it is recommended that when a project IRR is calculated to demonstrate additionality a pre-tax benchmark be applied."	The calculations are carried out to obtain the Project IRR. Therefore, the (nominal) pre-tax WACC[4] is selected as the benchmark. For calculating the pre-tax WACC, first the post-tax WACC is calculated and then converted to pre-tax WACC.	Satisfied
12	"Local commercial lending rates or weighted average costs of capital (WACC) are appropriate benchmarks for a project IRR."	WACC is selected as the appropriate benchmark.	Satisfied
17	"Only variables, including the initial investment cost, that constitute more than 20% of either total project	The sensitivity analysis only takes the variables into account, that have an impact on revenues or costs more than 20%.	Satisfied

[3] Only relevant guidance items are included from "Guidelines on the Assessment of Investment Analysis" v.3, EB51

[4] Weighted average cost of capital (WACC) is the rate that a company is expected to pay on average to all its security holders to finance its assets. The WACC is the minimum return that a company must earn on existing asset base to satisfy its creditors, owners, and other providers of capital, or they will invest elsewhere.

	costs or total project revenues should be subjected to reasonable variation"		
18	"...variations in the sensitivity analysis should at least cover a range of +10% and -10%."	The sensitivity analysis covers a range of -15% and +15%.	Satisfied

Outcome of Sub-step 2b: The benchmark analysis is applied and the approach is explained.

Sub-step 2c: Calculation and comparison of financial indicators

The following parameters are used for calculations;

Table 5. Parameters used for Investment Analysis

Parameter	Unit	Figure	Source	Justification
Investment Horizon	years	15	Assumption	The Guidelines suggest a minimum of 10 years and a maximum of 20 years.
Corporate Tax	%	20%	www.invest.gov.tr	This is the official corporate tax rate in the host country.
Discount Rate (Benchmark)	%	12.1%	WACC[5] calculations	Pre-tax WACC is suggested by the Guidelines.
Electricity Price	EUR¢/kWh	7	Assumption	This figure is used in the investment decision.
Carbon Credit Price	EUR/t_{CO2-eq}	7	Assumption	This figure is in line with current market conditions.
Initial Investment	tEUR	945	Feasibility Study	This figure is used in the investment decision.
Operation & Maintenance Costs	tEUR	170	Feasibility Study	This figure is used in the investment decision.

According to the agreement between the Municipality and the Project owner, the Project owner does *not* receive any revenues from the Municipality.

Scenario LFG1 & P1: Project <u>without</u> Carbon Credits

Since the Project involves no disposal fee paid by the Municipality, its revenue sources is limited to electricity sales (when VERs are not considered). Based on these data, the Project's IRR is calculated for the case where the Project would have been realized without carbon revenues. This corresponds to the scenario combination LFG1 & P1. The results are the following;

Table 6. Financial Performance of the Project <u>without</u> carbon revenues considered

Indicator	Unit	Source	IRR	Benchmark	Result

[5] Weighted average cost of capital (WACC) is the rate that a company is expected to pay on average to all its security holders to finance its assets. The WACC is the minimum return that a company must earn on existing asset base to satisfy its creditors, owners, and other providers of capital, or they will invest elsewhere.

Results:	%	Calculations	3.2%	12.1%	Unfeasible

In this scenario, the Project IRR calculations are carried out *without* considering carbon credit sales. The calculations conservatively assume that the revenues from electricity sales are obtained without delay (which may not reflect the actual case), that there are no major unforeseen malfunctions or other unforeseen expenses, and that the LFG generation occurs as expected.

The results indicate that without carbon credits, the Project is not feasible. Under these circumstances, the Project would not be attractive for a private investor.

Proposed Project Activity: Project with Carbon Credits

The proposed Project is realized with the additional inflow of revenues from carbon credit sales, the Project's profitability improves considerably;

Table 7. Financial Performance of the Project, with VER revenues considered

Indicator	Unit	Source	IRR	Benchmark	Result
Results:	%	Calculations	19.3%	12.1%	Feasible

In this case, it is observed that the IRR improves considerably with the inclusion of the carbon credit component and thus exceed the benchmarks. The Project IRR reaches investment levels because it exceeds the benchmarks.

Outcome of Sub-step 2c: Financial indicators are calculated and compared.

Sub-step 2d: Sensitivity analysis

The purpose of the sensitivity analysis is to check how much the Project's financial performance depends on main variables of the investment analysis. The Additionality Tool requires including those financial parameters in the analysis, that have 20% or more impact on the results. Two parameters are identified which satisfy this condition;

i. Electricity Prices (impact on revenues)
ii. Investment, Operation and Maintenance Costs (impact on costs)
iii. LFG Collection ratio (impact on revenues)

Both parameters are changed in the negative and positive directions to check how far they affect the Project profitability. The Additionality Tool suggests to at least cover an interval from -10% to +10% when varying the chosen input parameters. In order to assess the behaviour of the Project feasibility to a wider range of variations, an interval from -15% to +15% is chosen, with steps of 5% change. The results are as the following;

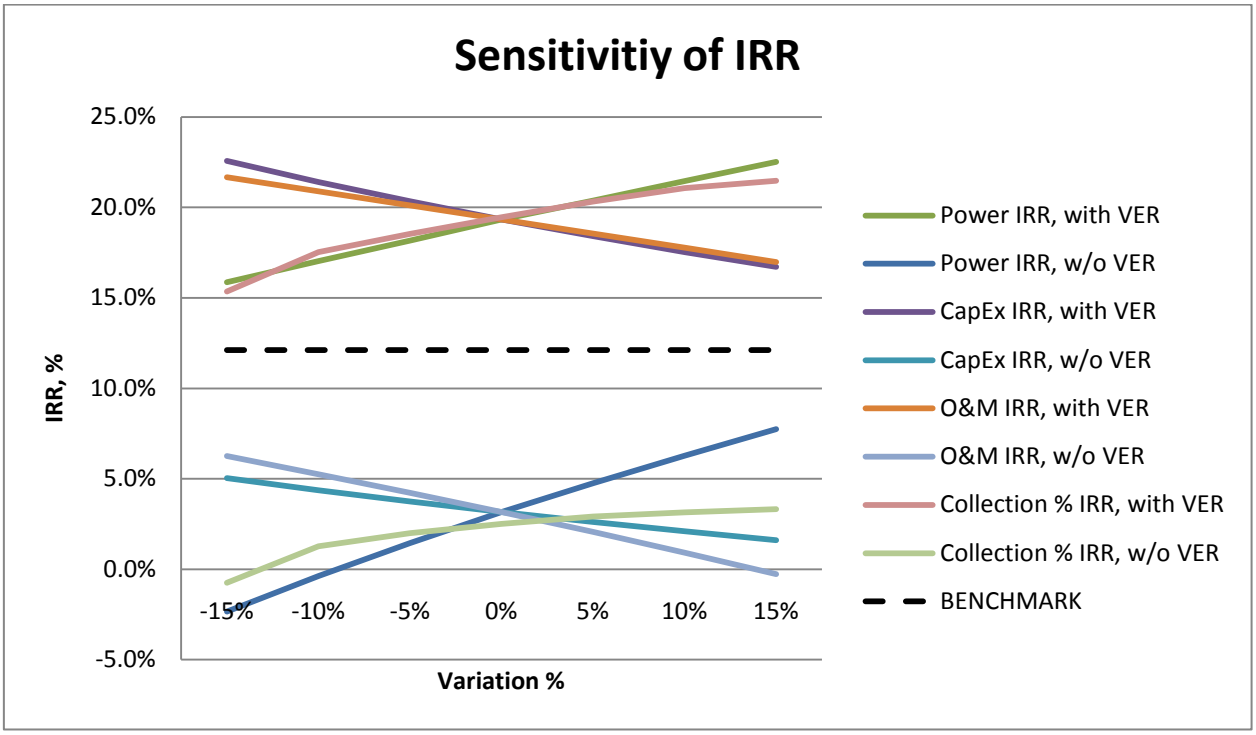


Figure 6. The sensitivity of Project feasibility on varying input parameters

The figure above depicts the reaction of the financial viability of the Project to the most important changing input parameters. With regards to Figure 6, the following conclusions are obtained:

a) **Impact of electricity prices on Project IRR ("Power IRR"):** There are two Power IRR lines in the Figure 6, the lower one representing the baseline scenario (LFG1&P1) without carbon revenues, and the upper line representing the proposed Project activity, including carbon revenues. The figure shows that the Project is quite sensitive to electricity prices. It furthermore shows that it is highly unlikely that the Project becomes feasible, even if the electricity prices would pick up significantly.

b) **Impact of capital expenditures on Project IRR ("CapEx IRR"):** The figure shows that as CapEx increases the IRR decreases (and vica versa) and that it is unlikely the Project becoming feasible even if CapEx would drop at significant amounts.

c) **Impact of LFG collection ratio ("Collection % IRR"):** The figure shows that the collection ratio of LFG significantly influences the IRR. As the collection ratio increases the IRR also increases considerably (and vice versa), but does not reach investment levels.

Conclusion: It is seen that in case the parameters change in positive direction, the Project does not exceed the benchmark threshold.

Outcome of Sub-step 2d: The sensitivity of financial indicators to input parameters is assessed.

Outcome of Step 2: The sensitivity analysis clearly demonstrates that the proposed Project activity is unlikely to be most financially/economically attractive and LFG1 & P1 is not a plausible alternative. According to the Additionality Tool, this satisfies the requirement of Step 2.

Step 3: Barrier analysis

This step is skipped.

Step 4: Common practice analysis

Currently, about 39% of the total population of Turkey is served with municipal disposal services. The rest of the population is either not served at all, or the municipal waste practice is limited to simple dumping on open areas. Under these circumstances, a waste-to-energy concept is quite innovative for stakeholders.

Table 8. Solid Waste Indicators in Turkey[6], 2006

Main Waste Indicators of Municipalities, 2008	
Total Number of municipalities	3 225
Number of municipalities receiving municipal waste services	3 129
Rate of population receiving waste services in total population (%)	82
Rate of population receiving waste services in total municipal population (%)	99
Amount of municipal waste collected (thousand tonnes/year)	24 361
Amount of municipal waste per capita (kg/capita-day)	1.15
Main Indicators of Waste Disposal and Recovery Facilities, 2008	
Rate of population served by waste disposal and recovery facilities in total municipal population (%)	47
Rate of population served by waste disposal and recovery facilities in total population (%)	39
Controlled landfill sites	
Number	37
Capacity (thousand tonnes)	390 478
Incineration plants	
Number	2
Capacity (thousand tonnes/year)	44
Composting plants	
Number	4
Capacity (thousand tonnes/year)	551

The Project is not common practice and it has not diffused in energy generation industry in the host country. This is demonstrated below;

Sub-step 4a: Analyze other activities similar to the proposed project activity:

As the geographical scope the host country is selected, because there is no sufficient evidence that suggests landfills in a specific region have considerably different characteristics than other regions or the host country.

The proposed Project activity is an IPP[7] investment by a private company for the purpose of generating electricity from LFG. In Turkey, the permission process starts with obtaining a generation license. In this

[6] Source: Turkish Statistical Institute (http://www.turkstat.gov.tr/PreIstatistikTablo.do?istab_id=496)

context, license holders can be defined as companies who have a certain extent of intention for an investment. IPP license holders are particularly similar to the Project activity, as they have the same purpose of generating and selling power to the national grid with similar legal framework. BOT and Autoproducer models cannot be regarded as similar, as they are based on different legal, financial and organizational conditions, which will be explained below.

Sub-step 4b: Discuss any similar Options that are occurring:

The following landfill projects have an electricity generation license from EMRA;

Table 9. Similar Project Activities in the Region[8]

Project Owner	License Type	Location	Capacity [MW]	VER Considered?	Description
ISTAC	Autoproducer[9]	Istanbul	4.0	No	Power generation from LFG (Municipality owned)
Ortadogu Enerji	IPP	Istanbul	13.9	Yes	Power generation from LFG
Ortadogu Enerji	IPP	Istanbul	7.6	Yes	Power generation from LFG
ITC-KA	IPP	Ankara	11.3	Yes	Power generation from LFG
ITC	IPP	Ankara	25	Yes	Power generation from LFG
ITC	IPP	Adana		Yes	Power generation from LFG
Ekolojik Enerji	IPP	Istanbul	1.0	No	Gasification facility for hazardous waste
Aksa Enerji	BOT[10] model	Bursa	1.4	Unknown	Power generation from LFG
CEV	IPP	Gaziantep	5.6	Yes	Power generation from LFG
Avdan Enerji	IPP	Samsun	1.2	Yes	Power generation from LFG

The first private power generation facilities which are in operation have been realized under BOT or Autoproducer models. Autoproducers generate electricity primarily for their own electricity consumption, and they are allowed to feed only a fraction of their generation to the grid. The BOT model is not applicable in Turkey anymore, as the existent BOT projects have special contracts with the government and will be handed over to the government after a certain period of time. As BOT and autoproducer power plants are not completely liberal electricity market players and are limited in terms of number and installed capacity, they cannot be considered as common practice or similar projects.

After the "liberalization" of the electricity market, which is still in a transformation period, investors have been allowed to build and operate their own power plants for electricity production and sales to the national grid as IPPs. Since the Project activity is an IPP, it cannot be compared to BOT or Autoproducer projects. Therefore, ISTAC and AKSA projects cannot be regarded as similar activities. The Ekolojik

[7] Independent Power Producer, generating and selling energy to the grid on commercial basis
[8] Source: http://www.epdk.gov.tr/lisans/elektrik/lisansdatabase/verilentesistipi.asp
[9] Autoproducer: Companies who generate energy mainly for their own consumption.
[10] Build-Operate-Transfer: This model enables parties to have specific, undisclosed contracts with particular exemptions, incentives and other mechanisms. This business model was applicable before the electricity market liberalization and cannot be regarded as a similar activity.

Enerji project deals with hazardous waste disposal and is out of the scope. The remaining Ortadogu and ITC-KA projects are similar activities, as they are IPPs that generate power from LFG. All these 3 projects have considered carbon credits. There are no other similar project activities which have been realized without the consideration of carbon credits.

Demonstration of additionality

Since banks refused to fund the Project and due to some time constraints, macroeconomic conditions and ongoing talks with the Bolu Municipality, the Project experiences considerable barriers for the realization of the Project. The Project has been designed and planned by considering carbon credits and the Project owner has considered carbon revenues earlier than project implementation, demonstrating early consideration of VER revenues.

The chronological history of the Project is as the following;

Table 10. Steps of the Project

Date	Action
20.01.2009	Bolu Municipality organizes a tender for managing the waste on its landfill.
09.02.2009	The Project owner wins the tender and concludes a contract with the Municipality.
17.02.2009	The Municipality issues site access permit to the Project owner.
22.08.2009	Technical experts from Korea make a site visit to carry out various gas tests and measurements.
06.03.2009	An informative meeting is organized in Bolu to inform stakeholders about the Project.
15.04.2009	Bolu Provincial Directorate of Environment and Forestry issues the "EIA is not required" document to the Project.
07.2009	Feasibility study contract is signed
28.09.2009	Contracting carbon consultants
17.06.2010	Electricity generation license obtained.
11.11.2010	Mobilisation start date.
25.11.2010	Equipment order is signed.
February 2011	Start day of site preparations (mobilisation)
01/06/2011	Expected start date of electricity generation

The identified barriers and results of the investment analysis are sufficient grounds for demonstration of additionality since they prevent potential project proponents from carrying out the proposed project activity undertaken without being registered as a VER project activity. The waste-to-energy concept constitutes a very limited portion of the Turkish electricity market; the Project Activity clearly goes beyond of "business as usual" scenario and cannot be considered as a common practice.

The regulations in the host country regarding landfill gas capture or destruction are not mandatory and there is a distinct lack of policies promoting efficient use of LFG (e.g. production of renewable energy, processing of organic waste etc.). Landfill site operators are not required to capture or destroy LFG, therefore the Project would have reduced GHG emissions compared to the case where it would not be realized at all. As a result, the Project is considered to be additional.

Outcome of Sub-step 4b: Other similar options are discussed and the additionality of the Project is demonstrated.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

The methodology requires that Project proponents should provide an ex-ante estimate of emission reductions, by projecting the future GHG emissions of the landfill. For the Project, a model based on the first order decay model was used in Project's feasibility study to determine estimated emission reductions ex-ante. Based on this model, the ex-ante emissions will be estimated. After the operation, the real emission reductions will be monitored ex-post.

Emission Reductions

According to the methodology, leakage does not need to be accounted, because the equipment will not be transferred to or from another activity. The emission reduction is the difference between the baseline emissions and project emissions;

$$ER_y = BE_y - PE_y \quad (1)$$

Definitions of all parameters used in the formulae below are provided in Annex 3 of this PDD.

Baseline emissions

The baseline emissions prior to the Project implementation consist of:

- The methane emitted to the atmosphere from the landfill; and
- The grid emissions due to electricity generation;

$$BE_y = (MD_{project,y} - MD_{BL,y}) * GWP_{CH4} + EL_{LFG,y} * CEF_{elec,BL,y} \quad (2)$$

The regulatory methane destruction is calculated as;

$$MD_{BL,y} = MD_{project,y} * AF \quad (3)$$

As the Project does *not* involve thermal power generation or gas supply to any pipeline, the methane destruction is calculated as;

$$MD_{project,y} = MD_{flared,y} + MD_{electricity,y} \quad (4)$$

Methane destroyed by flaring is found as;

$$MD_{flared,y} = (LFG_{flare,y} * w_{CH4,y} * D_{CH4}) - (PE_{flare,y} / GWP_{CH4}) \quad (5)$$

The project emissions due to flaring will be calculated by using the "Tool to determine project emissions from flaring gases containing methane";

$$PE_{flare,y} = \sum_{h=1}^{8760} TM_{RG,h}*(1-\eta_{flare,h})*GWP_{CH4}/1000 \quad (6)$$

The LFG generation is calculated using the first order decay method using the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site". Accordingly, the methane emissions avoided is found as;

$$BE_{CH4,SWDS,y} = \varphi*(1-f)*GWP_{CH4}*(1-OX)*16/12*F*DOC_f*MCF*\sum\sum W_{j,x}*DOC_j*e^{-kj(y-x)}*(1-e^{-kj}) \quad (7)$$

Baseline emissions due to electricity generation are calculated using the ACM0002 methodology. The Project mainly involves electricity capacity addition, which reduces CO_2 through the substitution of grid electricity generation with fossil fuel fired power plants by renewable electricity. ACM0002 offers two options for preparing the baseline calculation:

(a) A combined margin, consisting of the combination of operating margin (OM) and build margin (BM) according to the procedures prescribed in the 'Tool to calculate the emission factor for an electricity system', or;

(b) The weighted average emissions (in kg CO_{2e}/kWh) of the current generation mix. The data of the year in which project generation occurs must be used.

Option (a) above will be applied for the Project. The combined emission factor $CEF_{elec,BL,y}$ for the Project activity is calculated as a weighted average of Operating Margin and Build Margin emission factors. The operation margin refers to a cohort of power plants that reflect the existing power plants whose *electricity generation* would be affected by the proposed project activity. The build margin refers to a cohort of power plants that reflect the type of power units whose *construction* would be affected by the proposed project activity;

$$CEF_{elec,BL,y} = w_{OM}* EF_{grid,OM,y} + w_{BM}* EF_{grid,BM,y} \quad (8)$$

B.6.2. Data and parameters that are available at validation:

All parameters listed below have been selected according to the associated UNFCCC methodologies that are listed in section B.1;

Data / Parameter:	**$GEN_{i,y}$**
Data unit:	GWh
Description:	The gross electricity generation by fuel type i in year y (2002-2007)

Source of data used:	Turkish Electricity Transmission Company (TEİAŞ) website http://www.teias.gov.tr/ist2007/31(40-07).xls
Value applied:	Table 15. Gross and Net Electricity Generation [GWh] in Turkey
Justification of the choice of data or description of measurement methods and procedures actually applied :	TEİAŞ annually publishes official data regarding electricity generation on a fuel type basis.
Any comment:	

Data / Parameter:	**Net Electricity Generation$_y$**
Data unit:	GWh
Description:	The difference between the total quantity of electricity generated by power plants/units and the auxiliary electricity consumption of power plants/units.
Source of data used:	Turkish Electricity Transmission Company (TEİAŞ) website http://www.teias.gov.tr/ist2007/30(84-07).xls (2002-2007)
Value applied:	Table 15. Gross and Net Electricity Generation [GWh] in Turkey
Justification of the choice of data or description of measurement methods and procedures actually applied :	TEİAŞ annually publishes official data regarding *total* net electricity generation, but its *breakdown* by fuel type is unavailable.
Any comment:	

Data / Parameter:	**Net Delivery Ratio$_y$**
Data unit:	%
Description:	The ratio of the total Net Electricity Generation to the total Gross Electricity Generation in year y.
Source of data used:	Net Electricity Generation and Gross Electricity Generation data from http://www.teias.gov.tr/ist2007/30(84-07).xls http://www.teias.gov.tr/ist2007/31(40-07).xls
Value applied:	Table 15. Gross and Net Electricity Generation [GWh] in Turkey
Justification of the choice of data or description of measurement methods and procedures actually applied :	Electricity delivered to the grid by each power plant/unit is unavailable. The Net Delivery Ratio$_y$ is used for approximating the net electricity amount delivered to the grid by power plants/units except lc-mr sources (GEN$_y$).
Any comment:	This is a conservative assumption, since in general thermal power plants consume more energy for auxilaries than e.g. wind or hydro power plants. This assumption leads to higher net electricity amounts and lower emission reductions.

Data / Parameter:	**GEN$_y$**
Data unit:	GWh

Description:	The net electricity delivered to the grid in year y, excluding the low cost – must run sources
Source of data used:	Calculation steps (for each year y): 1. Gross electricity generation excluding lc-mr sources = Total gross electricity generation from all sources - total gross electricity generation from lc-mr sources 2. Net electricity generation excluding lc-mr sources = Gross electricity generation except lc-mr sources * Net Delivery Ratio 3. Net electricity delivered to the grid except lc-mr sources = Net electricity generation except lc-mr sources + Imports
Value applied:	Table 15. Gross and Net Electricity Generation [GWh] in Turkey
Justification of the choice of data or description of measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	**$EF_{CO2,i,y}$**
Data unit:	tCO_2/TJ
Description:	CO_2 emission factor of fossil fuel type i in year y
Source of data used:	The lower limits of the 95% confidence interval stated in the "2006 IPCC Guidelines for National Greenhouse Gas Inventories", Volume 2, Chapter 1 (energy) Table 1.4.
Value applied:	Table 24. NCVs and Emission Factors of Fuels
Justification of the choice of data or description of measurement methods and procedures actually applied :	Local Emission factor information is available for certain fuel types, which are submitted to the UNFCCC in the 2005 Turkey National GHG Inventory Report (NIR). For the fuel types which are not described in this NIR, industry guidelines are used instead.
Any comment:	

Data / Parameter:	**EI_y**
Data unit:	GWh
Description:	Net electricity imports delivered to the grid in year y
Source of data used:	Turkish Electricity Transmission Company (TEİAŞ) website http://www.teias.gov.tr/ist2007/30(84-07).xls
Value applied:	Table 15. Gross and Net Electricity Generation [GWh] in Turkey
Justification of the choice of data or description of measurement methods and procedures actually applied :	This is the total electricity imported and delivered to the national grid from connected electricity systems (neighbour countries).
Any comment:	

Data / Parameter:	**Electricity Capacity Additions**
Data unit:	-
Description:	Power plants which are most recently taken into operation
Source of data used:	Turkish Electricity Transmission Company (TEİAŞ) Capacity Projections (2007-2016, 2008-2017, 2009-2018) http://www.teias.gov.tr/projeksiyon/KAPASITEPROJEKSIYONU2009.pdf, http://www.teias.gov.tr/projeksiyon/KAPASITEPROJEKSIYONU2008.pdf, http://www.teias.gov.tr/projeksiyon/KAPASITE%20PROJEKSIYONU%202007.pdf, http://www.teias.gov.tr/istatistik2005/7.xls, http://www.teias.gov.tr/istat2004/7.xls, http://www.teias.gov.tr/istatistik/7.xls.
Value applied:	Table 23. Capacity Additions
Justification of the choice of data or description of measurement methods and procedures actually applied :	Average (not firm) generation values are used. This is conservative. Since capacity additions between 2004 - 2007 are not sufficiently large, a representative selection of power plants from 2003 has been included as well.
Any comment:	As the methodology suggests, isolated and retrofitted power plants/units and performance revisions are not considered in the sample power plant list.

Data / Parameter:	$\eta_{m,y}$
Data unit:	%
Description:	Average net energy conversion efficiency of power unit m in year y
Source of data used:	UNFCCC methodological tool "Tool to calculate the emission factor for an electricity system" Annex I
Value applied:	Table 26. Electricity Generation of Selected Recent Capacity Additions by Fuel Type
Justification of the choice of data or description of measurement methods and procedures actually applied :	There is no official efficiency values available based on each power plant or each fuel type. Therefore the default IPCC values are used, as listed in the "Tool to calculate the emission factor for an electricity system".
Any comment:	

Data / Parameter:	**AF**
Data unit:	N/A
Description:	National legislation and mandatory regulations
Source of data used:	The national legislation: "Control of Solid Waste Regulation" Article 27
Value applied:	Equation (3)
Justification of the choice of data or description of	The relevant national regulations regarding solid waste disposal do not require any LFG destruction or reduction. Therefore AF is taken as 0.

measurement methods and procedures actually applied :	
Any comment:	

Data / Parameter:	**φ**
Data unit:	N/A
Description:	Model correction factor to account for model uncertainties
Source of data used:	"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Value applied:	0.9
Justification of the choice of data or description of measurement methods and procedures actually applied :	Given the uncertainties associated with the model and in order to estimate emission reductions in a conservative manner, a discount of 10% is applied to the model results.
Any comment:	

Data / Parameter:	**OX**
Data unit:	N/A
Description:	Oxidation factor (reflecting the amount of methane from SWDS that is oxidized in the soil or other material covering the waste)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.1
Justification of the choice of data or description of measurement methods and procedures actually applied :	The Project site will be covered with soil, therefore OX=0.1 according to the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site".
Any comment:	

Data / Parameter:	**F**
Data unit:	N/A
Description:	Fraction of methane in the SWDS gas (volume fraction)
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories

Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	A preliminary sampling carried out on the Project site indicates a methane fraction around 0.6. A default value of 0.5 is recommended by IPCC, therefore 0.5 is used in a conservative manner.
Any comment:	

Data / Parameter:	**DOC_f**
Data unit:	N/A
Description:	Fraction of degradable organic carbon (DOC) that can decompose
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	0.5
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default value suggested by the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" is used.
Any comment:	

Data / Parameter:	**MCF**
Data unit:	N/A
Description:	Methane correction factor
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	1
Justification of the choice of data or description of measurement methods and procedures actually applied :	The Project site is a anaerobic managed solid waste disposal site with controlled placement of waste and the site will be covered with soil. According to the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site", a value of 1 shall be used for such sites.
Any comment:	

Data / Parameter:	**DOC_j**
Data unit:	N/A

Description:	Fraction of degradable organic carbon (by weight) in the waste type *j*
Source of data used:	IPCC 2006 Guidelines for National Greenhouse Gas Inventories
Value applied:	For different waste types, the fraction of DOC varies;

$W_{j,x}$	$DOC_{j,wet}$
Wood, wood products and straw	43%
Pulp, paper and cardboard (other than sludge)	40%
Food, food waste, sewage sludge, beverages and tobacco	15%
Textiles	24%
Other (non-food) organic putrescible garden and park waste	20%
Class, plastic, metal, other inert waste	0%

Justification of the choice of data or description of measurement methods and procedures actually applied :	The default DOC values for wet SW are used, in agreement with the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site". Unclassified SW types of nappies, rubber and leather are covered in the "Pulp, paper and cardboard" classification. Ceramics, soil and sand are covered in the "Glass, plastic, metal, other inert waste" classification.
Any comment:	

Data / Parameter:	**k_j**
Data unit:	N/A
Description:	Decay rate for the waste type *j*
Source of data used:	For k_j values: IPCC 2006 Guidelines for National Greenhouse Gas Inventories For climate data (1975-2006 Averages): National General Directorate for Meteorology (http://www.dmi.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?m=BOLU ; http://www.dmi.gov.tr/veridegerlendirme/yillik-toplam-yagis-verileri.aspx?m=BOLU)
Value applied:	For different waste types, the decay rate varies;

$W_{j,x}$	k_j
Wood, wood products and straw	0.02
Pulp, paper and cardboard (other than sludge)	0.04
Food, food waste, sewage sludge, beverages and tobacco	0.06
Textiles	0.04
Other (non-food) organic putrescible garden and park waste	0.05
Class, plastic, metal, other inert waste	0.00

(1) Justification of the choice of data or description of measurement methods and	(2) The "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" lists decay rates for different waste types. (3) Average temperate in Bolu over the year is 15.0 °C and annual precipitation is 553.3 mm. Based on these data, the selection of appropriate k_j values are made according to a "boreal and temperate"

procedures actually applied :	and "dry" climate. (4) Unclassified SW types of nappies, rubber and leather are covered in the "Pulp, paper and cardboard" classification. Ceramics, soil and sand are covered in the "Glass, plastic, metal, other inert waste" classification.
(5) Any comment:	

Data / Parameter:	**ρ_{CH4}**
Data unit:	t/m^3
Description:	(6) Density of methane at normal conditions
Source of data used:	"Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Value applied:	0.0007168
Justification of the choice of data or description of measurement methods and procedures actually applied :	The methane density under normal conditions (0° C and 1,013 bar) is constant.
Any comment:	

Data / Parameter:	**GWP_{CH4}**
Data unit:	t_{CH4}/t_{CO2eq}
Description:	Global Warming Potential of methane valid for the commitment period
Source of data used:	"Tool to determine project emissions from flaring gases containing methane"
Value applied:	21
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default GWP value of 21 is used as suggested by the UNFCCC tool.
Any comment:	

Data / Parameter:	**COL**
Data unit:	%
Description:	Collection Ratio of the generated LFG

Source of data used:	Feasibility Study
Value applied:	70%
Justification of the choice of data or description of measurement methods and procedures actually applied :	The collection system which will be installed on the Project site will be able to collect a certain fraction of the total LFG generation. This collection ratio is affected principally by the Project's technical design, therefore the value suggested in the feasibility study is used.
Any comment:	

Data / Parameter:	η_{flare}
Data unit:	N/A
Description:	Flaring efficiency of the flare
Source of data used:	"Tool to determine project emissions from flaring gases containing methane"
Value applied:	90%
Justification of the choice of data or description of measurement methods and procedures actually applied :	The default efficiency for enclosed flares will be used as long as manufacturer's specifications for efficient operation are complied with. The determination of the flare efficiency will be based on "enclosed flares and use of the default value". The flare will be monitored with probes with an adequate frequency; • 0%, if the temperature in the exhaust gas of the flare (T_{flare}) is below 500 °C for more than 20 minutes during the hour h . • 50%, if T_{flare} is above 500 °C for more than 40 minutes during the hour h, but the manufacturer's specifications on proper operation of the flare are not met at any point in time during the hour h. • 90%, if T_{flare} is above 500 °C for more than 40 minutes during the hour h and the manufacturer's specifications on proper operation of the flare are met continuously during the hour h. For estimating the amount of flared methane ex-ante, 90% is used.
Any comment:	

Data / Parameter:	$BE_{CH4,SWDS,y}$
Data unit:	t_{CO2-eq}
Description:	Methane generation from the landfill in the absence of the project activity at year *y*
Source of data used:	Calculated as per the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Value applied:	Equation (7)
Justification of the	The Feasibility Study of the Project employs a First Order Decay model, which

choice of data or description of measurement methods and procedures actually applied :	is not compatible with the UNFCCC "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site". Therefore, this parameter has been calculated in the PDD separately.
Any comment:	

B.6.3 Ex-ante calculation of emission reductions:

The Project's emission reductions stem from the prevention of methane emissions to the atmosphere from the SWDS as well as substitution of electricity by generation of electrical power from the LFG. There are basically two components of the baseline emissions;

i. Landfill gas, and;

ii. Electricity generation.

i. Landfill Gas Component

The Project will make use flow meters to measure the LFG amounts and characteristics of the total collected LFG ($LFG_{total,y}$), LFG went to flaring ($LFG_{flared,y}$), and LFG went to the generator ($LFG_{electricity,y}$).

In order to calculate the LFG generation of the selected site, the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site" suggests the use of the Equation (7). Using the LFG figures, the methane destroyed by the Project is found by using Equation (4), (5) and (6).

For the purpose of calculation of the LFG generation, the First Order Decay model is used, as required. The amount of SW dumped on the Project site is calculated using sophisticated models by the Project owner. The flow of waste amount is found out to be as:

Table 11. Composition and Amount of Disposed Waste on Project Site

Wj,x	Total Disposal on Project Site	Wood, wood products and straw	Pulp, paper and cardboard (other than sludge)	Food, food waste, sewage sludge, beverages and tobacco	Textiles	Other (non-food) organic putrescible garden and park waste
Fraction, %	*100%*	*0%*	*23%*	*44%*	*1%*	*0%*
1992	*35,000*	0	8,190	15,470	490	0
1993	*35,000*	0	8,190	15,470	490	0
1994	*35,000*	0	8,190	15,470	490	0
1995	*35,000*	0	8,190	15,470	490	0
1996	*35,128*	0	8,220	15,527	492	0
1997	*36,453*	0	8,530	16,112	510	0
1998	*36,658*	0	8,578	16,203	513	0
1999	*39,128*	0	9,156	17,295	548	0
2000	*38,659*	0	9,046	17,087	541	0
2001	*39,785*	0	9,310	17,585	557	0
2002	*41,610*	0	9,737	18,392	583	0
2003	*41,729*	0	9,765	18,444	584	0
2004	*42,426*	0	9,928	18,752	594	0
2005	*46,628*	0	10,911	20,610	653	0
2006	*48,339*	0	11,311	21,366	677	0
2007	*43,284*	0	10,128	19,131	606	0
2008	*42,926*	0	10,045	18,973	601	0
2009	*42,900*	0	10,039	18,962	601	0
2010	*42,900*	0	10,039	18,962	601	0
2011	*42,900*	0	10,039	18,962	601	0
2012	*42,900*	0	10,039	18,962	601	0
2013	*42,900*	0	10,039	18,962	601	0

Using appropriate decay rates k_j and fractions of degradable organic carbon DOC_j and taking the capacities of the generator and the flare, the Equation (7) results in the following LFG generation figures:

Table 12. Amounts of generated and collected LFG

Year	Total LFG generation on site, as m3 LFG	Maximum collectable LFG [m3]	Methane destroyed by flaring (eligible) [tCO2]	Methane destroyed by electricity generator [tCO2]	Ratio of met. for power gen. / total met. destruction [%]
2011	4,104,708	1,692,489	1,697	10,853	86%
2012	4,181,464	2,927,024	3,245	18,425	85%
2013	4,252,309	2,976,616	3,581	18,425	84%
2014	4,317,832	3,022,483	3,891	18,425	83%
2015	4,378,545	3,064,982	4,179	18,425	82%
2016	4,434,896	3,104,427	4,446	18,425	81%
2017	4,487,278	3,141,095	4,695	18,425	80%
2018	4,536,039	3,175,228	4,926	18,425	79%

The project emissions from flaring shall be subtracted from the methane destroyed by flaring, using the Equation (6), as explained in the "Tool to determine project emissions from flaring gases containing methane. It is assumed that an enclosed flare will be operated in agreement with its manufacturer's specifications and will be monitored.
Accordingly, the $PE_{flare,y}$ is found as;

Table 13. Project Emissions from Flaring [t_{CO2}]

Year	$TM_{RG,y}$ ($LFG_{flared,y}$ [tCO_2])	η_{flare} [%]	$PE_{flared,y}$ [tCO_2]
2011 (partial)	53	90%	111
2012	172	90%	361
2013	189	90%	398
2014	206	90%	432
2015	221	90%	464
2016	235	90%	494
2017	248	90%	522
2018 (partial)	107	90%	225

Using these results, the net methane amount destroyed is found with the Equation (3), (4) and (5);

Table 14. Calculation of destroyed methane by flaring

Year	$MD_{flared,y}$ [tCH_4]	$MD_{electricity,y}$ [tCH_4]	$MD_{project,y}$ [tCH_4]	$MD_{electricity,y}$ / $MD_{project,y}$	AF	$MD_{BL,y}$ [tCH_4]
2011 (partial)	1,000	6,393	7,392	86%	0%	0
2012	3,245	18,425	21,669	85%	0%	0
2013	3,581	18,425	22,005	84%	0%	0
2014	3,891	18,425	22,316	83%	0%	0
2015	4,179	18,425	22,604	82%	0%	0
2016	4,446	18,425	22,871	81%	0%	0
2017	4,695	18,425	23,119	80%	0%	0
2018 (partial)	2,024	7,572	9,596	79%	0%	0

ii. Electricity Generation Component

As the Project's electricity generation does not exceed the UNFCCC threshold of 15 MW, the Project is eligible for using the small scale methodologies for electricity generation. According to the "Tool to calculate the emission factor for an electricity system", the missing parameters are the emission factors $EF_{GRID,OM,y}$ and $EF_{GRID,BM,y}$, which shall be calculated in 6 subsequent steps.

STEP 1. Identify the relevant electric power system

No recent or future addition to the national transmission capacity is reported or foreseen, which would enable Turkey to significantly increase its electricity imports. Therefore, a likely transmission line construction is not considered in BM emission factor calculations. Turkey imports electrical power from and exports to neighbour countries[11], which are defined as *connected electricity systems* for the Project. According to the baseline methodology, imports are regarded as a power source delivering electricity to the grid with an OM emission factor of 0 tCO_2, since electricity being imported is purchased from connected electricity systems located in other countries.

STEP 2. Select an operating margin (OM) method

As explained above, the ex-ante combined margin method will be used.

There exists no nuclear power plant in Turkey, and there is no indication that coal or lignite is obviously used as must-run. Hydro, geothermal, wind power plants and other renewables are included as low-cost/must-run resources, hereafter referred as *lc-mr*, which turns out to be 25.0% of the total electricity generation on average between years 2003 and 2007.

Since the share of lc-mr resources is less than 50% on average of the five most recent years and as available data are limited, the simple OM method will be implemented.

Table 15. Gross and Net Electricity Generation [GWh] in Turkey

GENERATION DATA BY SOURCE, GWh	2004	2005	2006	2007	2008	Avg. Share
Coal	11,998	13,246	14,217	15,136	15,858	8.0%
Lignite	22,450	29,946	32,433	38,295	41,858	18.6%
Fuel Oil	6,690	5,121	4,232	6,470	7,209	3.4%
Diesel oil	7	3	58	13	266	0.0%
LPG	33	34	0	0	0	0.0%
Naphtha & Aphaltite	940	326	50	44	44	0.2%
Natural Gas	62,242	73,445	80,691	95,025	98,685	46.4%
Renewables and wastes	104	122	154	214	220	0.1%
Hydro	46,084	39,561	44,244	35,851	33,270	23.1%
Geothermal & Wind	151	153	221	511	1,009	0.2%
Gross Total	**150,698**	**161,956**	**176,300**	**191,558**	**198,418**	100.0%
Gross Total excluding lc-mr	104,360	122,120	131,681	154,983	163,919	
Net Generation	145,066	155,469	169,543	183,340	189,762	
Net Delivery Ratio	96.3%	96.0%	96.2%	95.7%	95.6%	
Imports	463.5	635.9	573.2	864.3	789.4	
Net Delivered to Grid, exc. lc-mr	*100,923*	*117,864*	*127,208*	*149,198*	*157,558*	

[11] Since 2001: Exports to Georgia, Azerbaijan, Iraq, Syria. Imports from Bulgaria, Iran, Turkmenistan, Georgia. Sources: http://www.teias.gov.tr/ist2006/49.xls, http://www.teias.gov.tr/ist2006/47.xls

The UNFCCC methodology suggests using local, publicly available data whenever possible. In the lack of local data, industry guidelines shall be used in a conservative manner. 2005-2007 national emissions figure stemming from electricity generation is publicly available and used for OM calculations.

STEP 3. Calculate the operating margin emission factor according to the selected method

According to the "Tool to calculate the emission factor for an electricity system", the OM emission factor, $EF_{GRID,OM,y}$, is found as;

$EF_{GRID,OM,y} = EM_{grid,y} / EG_y$, (9)

Using official CO_2 emissions data instead of calculated figures, the **Operating Margin Emission Factor, $EF_{GRID,OM}$**, is found to be as the following;

Table 16. Calculation of the OM emission factor

Operating Margin EF	**2006**	**2007**	**2008**	**Note**
CO_2 Emissions, $ktCO_2$ (Official Data)	85,312	100,662	101,473	used
CO_2 Emissions, $ktCO_2$ (Calculation)	82,844	98,099	103,714	not used
Net Electricity Supplied to grid, GWh	127,208	149,198	157,558	
OM Emission Factor in year y, tCO_2/MWh	0.671	0.675	0.644	
Operating Margin EF 2006-2008, tCO2/MWh	**0.663**			

STEP 4. Identify the cohort of power units to be included in the build margin

In this step, a generation-weighted average emission factor is calculated based on a sample of power plants, which have been taken into operation recently. The sample group of power plants/units *m* used to calculate the build margin consists of either:

(a) The set of five power units that have been built most recently

(b) The set of power capacity additions in the electricity system that comprise 20% of the system generation (in MWh) and that have been built most recently.

For conducting the calculations, option (b) is selected, because this option results in a larger electricity generation. The data of the most recent commissioned power plants are being published by the Turkish Electricity Transmission Company (TEİAŞ) on an annual basis. For build margin calculations, the power plants/units taken into operation between 2003-2007 are included in the cohort of power units. Performance revisions, modifications, retrofits and dismantlings of power plants or are stand-alone have been excluded from the samples list for the build margin calculations.

Based on these requirements and conditions, the final list of selected power plants is summarized in Annex 3.

STEP 5. Calculate the build margin emission factor

The build margin emission factor is the generation-weighted average emission factor (tCO_2/MWh) of all power units m during the most recent year y for which power generation data is available, calculated as follows;

$$EF_{GRID,BM,y} = \frac{\sum_m EG_{m,y} * EF_{EL,m,y}}{\sum_m EG_{m,y}} \qquad (10).$$

The $EF_{EL,m,y}$ is found as;

$$EF_{EL,m,y} = \frac{EF_{CO2,m,i,y} * 3{,}6}{\eta_{m,y}} \qquad (11)$$

Using the sample list of recently built power plants, the **Build Margin Emission Factor, $EF_{GRID,BM}$**, is found as;

Table 17. CO_2 Emissions of Recent Capacity Additions by Fuel Type

Build Margin EF				
Fuel Type	**Generation of New Capacity Additions**	**Average Efficiency, η**	**Emission Factor, tCO_2/TJ**	**CO_2 Emissions, $ktCO_2$**
Coal	1,125.0	40.0%	90.8	919
Lignite	11,451.1	40.0%	90.9	9,368
Fuel Oil	1,474.9	46.0%	75.5	871
Diesel oil	0.0	46.0%	72.6	0
LPG	0.0	60.0%	61.6	0
Naphtha & Asphaltite	323.5	46.0%	69.3	175
Natural Gas	25,083.9	60.0%	54.3	8,172
Renewables and wastes	119.0	N/A	0.0	0
Hydro	3,243.3	N/A	0.0	0
Geothermal & Wind	108.4	N/A	0.0	0
Total	**42,929.0**			**19,507**
Build Margin EF 2006-2008, tCO2/MWh	**0.454**			

Power plant-specific data are unavailable in Turkey; therefore CO_2 emissions are calculated based on fuel type consumed in sample power plants/units. Data regarding electricity generation efficiency rates in Turkey are not available for each power plant in the sample list. Efficiency rates of already operating large power plants do exist[12], however they are not/partially included in the sample list. The average efficiency for each fuel type from the existing efficiency rates are assumed as the chosen efficiency for calculation purposes.

[12] Environmental Map of Turkey, 2004 (Published by General Directorate of Environmental Works of Turkey)

The "Tool to calculate the emission factor for an electricity system" requires the sample list of recent capacity additions to constitute at least 20% of the system generation. This requirement is met;

Table 18. Generation of Recent Capacity Additions

Generation Sample List	Generation [GWh]
2008 Generation, GWh	191,558
UNFCCC Threshold, % of Generation	20%
UNFCCC Threshold, GWh	38,311.6
Capacity Additions, 2004-2008 GWh	42,929.0

STEP 6. Calculate the combined margin emissions factor

The combined margin emissions factor is calculated by using Equation (8). The weights are taken as 50% for both factors, as the "Tool to calculate the emission factor for an electricity system" suggests.

$CEF_{elec,y}$=0.663 t_{CO2}/MWh * 0.50 + 0.454 t_{CO2}/MWh * 0.50 = **0.559 t_{CO2}/MWh**

Project emissions and leakage are not considered. The main emissions potentially giving rise to leakage in the context of electric sector projects are emissions arising due to activities such as power plant construction and upstream emissions from fossil fuel use (e.g. extraction, processing, transport). These emissions sources are neglected in agreement with the baseline methodology.

B.6.4 Summary of the ex-ante estimation of emission reductions:

The results of the baseline calculations are as follows;

Table 19. Summary of Emission Factors for Electricity Generation

Parameter	Definition	Value
$EF_{GRID,OM}$	Operating Margin Emission Factor	0.663
$EF_{GRID,BM}$	Build Margin Emission Factor	0.454
w_{OM}	Weight of the Operating Margin	50%
w_{BM}	Weight of the Build Margin	50%
CEF_{elec}	Combined Margin Emission Factor	0.559

Table 20. Results of the Emission Reduction Calculations

Year	Estimation of project activity emissions (tonnes of CO2 e)	Estimation of baseline emissions (tonnes of CO2 e)	Estimation of leakage (tonnes of CO2 e)	Estimation of overall emission reductions (tonnes of CO2 e)
2011 (partial)	189	13,826	0	13,637
2012	361	23,835	0	23,475

2013	398	24,171	0	23,773
2014	432	24,482	0	24,049
2015	464	24,770	0	24,305
2016	494	25,037	0	24,543
2017	522	25,285	0	24,764
2018 (partial)	547	15,030	0	14,483
Total (tonnes of CO2e)	**3,407**	**176,436**	**0**	**173,029**

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	**$PE_{FC,j,y}$**
Data unit:	$tCO2_e$
Description:	Project emissions from fossil fuel combustion in process *j* during the year *y*
Source of data to be used:	Calculated as per the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion".
Measurement procedures (if any):	This data will be calculated based on the actual fossil fuel consumption by the Project activity as auxiliary fuel.
Monitoring frequency:	Annually.
QA/QC procedures:	The consumption of fossil fuel will be monitored based on the fuel invoices and is therefore of high quality.
Any comment:	

Data / Parameter:	**$MG_{PR,y}$**
Data unit:	tCH_4
Description:	Amount of methane generated during year *y* of the project activity
Source of data to be used:	Project proponents
Measurement procedures (if any):	Estimated using the actual amount of waste disposed in the landfill as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site"
Monitoring frequency:	Annually.
QA/QC procedures:	The amount of waste disposed is recorded electronically at the landfill site entrance with a weighing machine and is therefore of high quality.
Any comment:	

Data / Parameter:	**$LFG_{total,y}$**
Data unit:	Nm^3
Description:	Total amount of landfill gas (under normal pressure and temperature) captured in year y
Source of data to be used:	The flow meter readings installed at the LFG pipe
Measurement procedures (if any):	
Monitoring frequency:	Data will be measured continuously with a flow meter by the Project owner. The flow meter will be maintained and calibrated regularly in line with the manufacturer's recommendations. This will ensure that the accuracy of the measurement instrument is maintained.
QA/QC procedures:	Data will be aggregated monthly and yearly. Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy. The measurement interval will be equal to or more than one sampling each hour.
Any comment:	

Data / Parameter:	**$LFG_{flare,y}$**
Data unit:	Nm^3
Description:	Total amount of landfill gas (under normal pressure and temperature) flared in year y
Source of data to be used:	The flow meter installed at the pipe feeding the flare
Measurement procedures (if any):	This parameter will be measured by a dedicated measurement device in accordance with UNFCCC and device manufacturer's requirements.
Monitoring frequency:	There will a separate flow meter for each of the flare units, as required by the Methodology. Data will be measured continuously with a flow meter by the Project owner. The flow meter will be maintained and calibrated regularly in line with the manufacturer's recommendations. This will ensure that the accuracy of the measurement instrument is maintained.
QA/QC procedures:	Data will be aggregated monthly and yearly for each flare unit. Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy. The measurement interval will be equal to or more than one sampling each hour.
Any comment:	

Data / Parameter:	**$LFG_{electricity,y}$**
Data unit:	Nm^3
Description:	Total amount of landfill gas (under normal pressure and temperature) combusted in the generator unit in year y
Source of data to be used:	The flow meter readings installed at the pipe feeding the generator unit(s)
Measurement procedures (if any):	This parameter will be measured by a dedicated measurement device in accordance with UNFCCC and device manufacturer's requirements.
Monitoring frequency:	There will a separate flow meter for each of the generator units, as required by the Methodology. Data will be measured continuously with a flow meter by the Project owner. The flow meter will be maintained and calibrated regularly in line with the manufacturer's recommendations. This will ensure that the accuracy of the measurement instrument is maintained.
QA/QC procedures:	Data will be aggregated monthly and yearly for each generator unit. Flow meters will be subject to a regular maintenance and testing regime to ensure accuracy. The measurement interval will be equal to or more than one sampling each hour.
Any comment:	

Data / Parameter:	**w_{CH4}**
Data unit:	%
Description:	Methane fraction in the landfill gas
Source of data to be used:	Flow meter , by the Project owner
Measurement procedures (if any):	50%
Monitoring frequency:	Methane content will be measured directly and continuously with a gas analyser by the project onwer. The gas analyser will be maintained and calibrated regularly according to the manufacturer's requirements in order to ensure that required level of accuracy is maintained.
QA/QC procedures:	The gas analyser will be subject to a regular maintenance and testing regime to ensure accuracy, therefore the analyser will be calibrated according to the manufacturer's recommendations. A zero check and a typical value check will be performed by comparison with a standard certified gas. The measurement interval will be equal to or more than one sampling each hour.
Any comment:	

Data / Parameter:	**$PE_{flare,y}$**
Data unit:	t_{CO2-eq}
Description:	Project Emissions from flaring in year *y*
Source of data to be used:	Calculated by project owner
Measurement procedures (if any):	This parameter will be calculated.
Monitoring frequency:	Data will be calculated based on the default values for the flare efficiency ($\eta_{flare,h}$) and the flow meter readings ($FV_{RG,h}$) from the Project Developer according to the "Tool to determine project emissions from flaring gases containing methane".
QA/QC procedures:	Data will be aggregated yearly. Flow meters will be subject to a regular maintenance to ensure accuracy.
Any comment:	

Data / Parameter:	**T_{flare}**
Data unit:	°C
Description:	Temperature in the exhaust gas of the flare
Source of data to be used:	The thermocouple installed at the pipe feeding the flare
Measurement procedures (if any):	This parameter will be measured by a dedicated measurement device in accordance with UNFCCC and device manufacturer's requirements.
Monitoring frequency:	Measurement of the temperature of the stack gas with an N-type thermocouple. Temperatures above 500 °C indicate that the flare is operating.
QA/QC procedures:	The thermocouple should be subject to a regular calibration or replacement every year to ensure accuracy.
Any comment:	

Data / Parameter:	**Operation of the power plant**
Data unit:	h
Description:	Operation of the power plant
Source of data to be used:	Project owner
Measurement procedures (if any):	N/A
Monitoring frequency:	Data will be recorded annually by the project developer to ensure methane destruction is claimed for methane used in electricity plant when it is operational.

QA/QC procedures:	Equipment will be maintained according to the manufacturer's recommendations to assure a good operation.
Any comment:	

Data / Parameter:	**AF**
Data unit:	%
Description:	Regulatory requirements relating landfill gas projects
Source of data to be used:	National laws and regulations.
Measurement procedures (if any):	0. (No enforced regulations relating to landfill gas recovery or power generation projects)
Monitoring frequency:	This information will be checked yearly.
QA/QC procedures:	In case of a change of the Article 27 of the relevant regulation "Control of Solid Waste Regulation", this change will be included in the monitoring report.
Any comment:	

Data / Parameter:	**$EL_{LFG,y}$**
Data unit:	MWh
Description:	Quantity of net electricity generation supplied by the project plant/unit to the grid in year y
Source of data to be used:	PMUM reports. PMUM is the financial settlement centre of TEIAS, which has an online user interface for reporting purposes. PMUM web site can list a detailed overview of electricity generation and consumption figures of power plants, based completely on the measurement device readings carried out by TEIAS personnel.
Measurement procedures (if any):	For calculating expected emission reductions, the "estimated" amount of annual net electricity generation is used.
Monitoring frequency:	Data will be obtained on-line from the PMUM web site by the project owner using its own unique ID and password. The PMUM reports will be then submitted to the DOE for monitoring purposes. The PMUM data are based on measurement device readings carried out on site by TEIAS personnel. Two TEIAS-calibrated and approved measurement devices will be installed, which measure the net electricity supply to the national grid by the Project. The switchgear station on the Project site constitutes the border between the Project and the national electricity grid. Both measurement devices, which continuously monitor and measure the net electricity delivered by the Project to the grid. TEIAS-approved measurement protocols each month will be uploaded to the PMUM web site.

	The metering device does not measure the net electricity generation but the gross generation and self consumption separately. Their difference gives the net electricity generation, which is going to be listed on a monthly basis for monitoring purposes.
QA/QC procedures:	The measurement devices will be selected in agreement with the relevant regulations, ensuring a certain data storage and measurement quality in terms of accuracy etc. PMUM is owned and operated by the public transmission line operator TEIAS, which purchases the electricity from the project owner. Therefore, PMUM reports offer a conservative, dependable and correct way for monitoring net electricity supplied to the grid. There is no sampling involved in monitoring. All data used will be measured, increasing the accountability of the calculated emission reductions. In order to maintain uninterrupted measurement and to prevent technical errors, a back-up measurement device will also be installed, which will continuously measure and store generation and consumption data real-time, parallel to the main measurement device. Before installation, both measurement devices will be calibrated by TEIAS. If a malfunctioning is observed during operation, the measurement device will again be inspected and calibrated by TEIAS. Both measurement devices will be sealed and only accessible by TEIAS personnel. Project staff or any other personnel will have no control over or access to the measurement devices. Measured data will be both kept by the project owner and the PMUM web site for at least 2 years. The net electricity supplied to the grid will be calculated by subtracting Project's own consumption from gross generation figure. This calculation will be done with a spreadsheet in order to allow easy understanding, transparency and correct computation purposes with minimum human intervention.
Any comment:	The annual emissions reductions will be updated by multiplying the ex-ante calculated baseline emission factor by the PMUM-reported amount of net electricity supplied to the grid. The emission factor will not be updated.

B.7.2 Description of the monitoring plan:

The monitoring plan overview can be visualized as below:

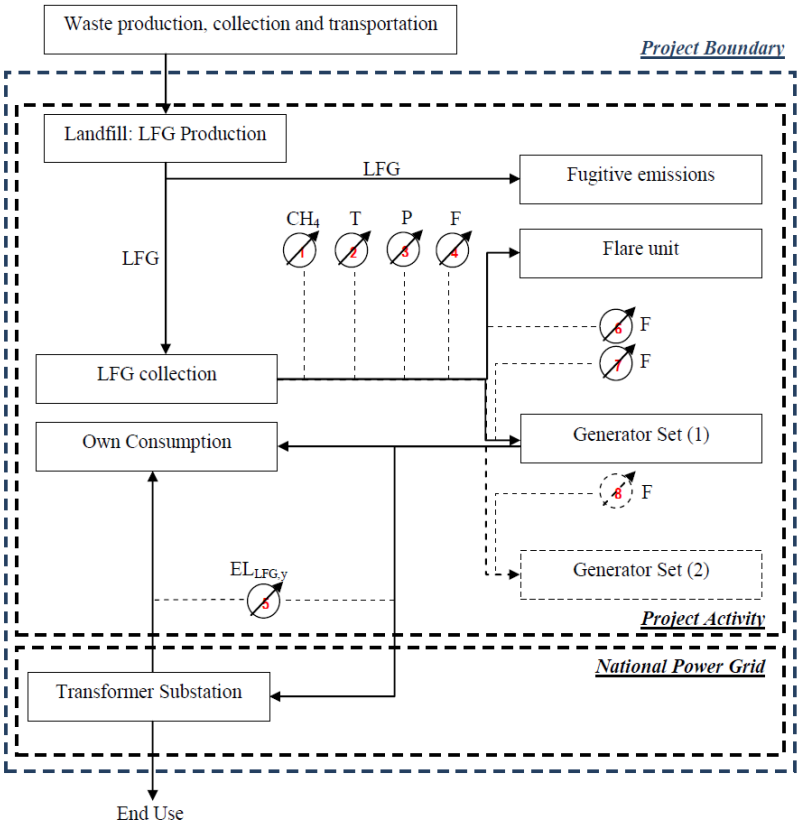


Figure 7. Monitoring System Flowchart

The monitoring instruments to be installed include LFG flow meters, methane meters, pressure and temperature gauges and electricity measurement devices. All the monitoring instruments will meet the relevant accuracy requirements.

Table 21. Summary of the monitoring plan

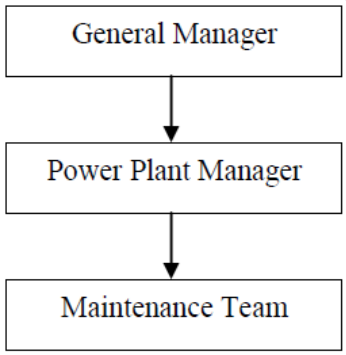
Parameter	Explanation	Measurement Device Number
$w_{CH4,y}$	Methane fraction in the landfill gas	1
T	Temperature	2
P	Pressure	3
$LFG_{total,y}$	Total amount of landfill gas captured at normal temperature and pressure	4
$EL_{LFG,y}$	Net amount of electricity supplied to the grid by the Project	5
$LFG_{flare,y}$	Amount of landfill gas flared at normal temperature and	6

	pressure	
$PE_{flare,y}$	Project emissions from flaring	6
$LFG_{electricity,y}$	Amount of landfill gas combusted in the power plant at normal temperature and pressure	7, 8, ...
Operation of the power plant	Annual operational hours	7,8, ...

All data used for the monitoring plan will be archived electronically and backed up regularly. These data will be kept for the full crediting period and a further two years after the end of the crediting period or the last issuance of VERs, whichever occurs later. The monitoring plan mainly involves proper preparation of a spreadsheet and reporting of it. Monitoring will be carried out with the help of a spreadsheet.

Please refer to section B.7.1 for details.

Responsibilities and Management Structure for Monitoring



The responsible person for the monitoring of the Project is the general manager of the Project owner. The Project owner will appoint a project manager who will collect the data. The data will be processed and reported in agreement with the monitoring plan by the general manager. The general manager can assign a carbon consultant for these tasks.

The general manager of the Project owner is responsible for overseeing the implementation of the monitoring procedure. Competency requirements for these tasks will be applied to ensure that the general manager is able to implement and/or supervise this procedure. The general manager will be responsible of the emission reduction calculations and the preparation of necessary documents for verification.

The general manager will appoint the power plant manager for data collection, checking instrumentation, record keeping, data handling and data processing, filing, reporting, organising repair and maintenance of monitoring equipment and ensuring the monitoring plan is adhered to as indicated in the approved PDD. The general manager will ensure that the personnel of the Project owner acquire the skills to carry out these tasks properly through capacity building practices and trainings.

The maintenance staff will receive technical trainings, as well as health and safety trainings to minimise exposure to workplace hazards. At every shift, at least one trained technical personnel will be present. All relevant information such as data files, maintenance and defect records and other monitoring related records will be kept at a designated location in a transparent and organised manner.

The SCADA monitoring system of the Project in general follows the requirements of methodology ACM0001 version 11. The Figure 7 shows the overview of the monitoring system and the measurement devices.

Data Collection and Management

Remote Monitoring: All important parameters that are needed to determine the avoided emissions will be able to be monitored from the control room of the Project as well as remotely from the company office.

The SCADA system will record meter readings at pre-determined intervals, as specified in the CDM monitoring manual. These data will be used to calculate the total emission reductions.

Manual Recording of Data: The general manager will implement a manual data recording system to act as a back-up for the on-line monitoring system. This basic back-up system will consist of regular updating of a spreadsheet manually that includes the main key parameters.

Data Archiving: The electronic monitoring system will periodically archive the readings data. Written documents (e.g. equipment replacement protocols, accident logs, maintenance records, back-ups etc.) will be kept safely. These data will be stored until 2 years after the end of the crediting period. The general manager will implement a document control system that ensures that the correct versions of documents that might be necessary for verification purposes are available whenever needed.

Data corruption: If data in the SCADA system are corrupted or missing during the operational hours (which can be proven by the records of the electricity meters), the missing data can be estimated by the following procedure: the value of that parameter one hour before the error, one hour after the system restart, and the average from the previous 24 hours will be determined and the lowest figure of those will be used. For other cases, any deficiencies in methane flow monitoring data will be rectified by calculation from power generation in a conservative manner.

Maintenance and calibration of meters

All measurement devices will be purchased and maintained as specified in the CDM monitoring manual according to manufacturer specifications. All measurement devices that are used in monitoring will be subject to a quality control procedure that will include regular maintenance and calibration in agreement with legal and/or manufacturer requirements. According to the relevant regulation[13], periodical inspections of "gauges for electric, water, coal gas, natural gas and, current and voltage measuring transformers will be made once in 10 years".
For every calibration, a separate calibration record will be kept that shows the identification number of each measurement device, calibration date, due date for next calibration, calibration service provider etc. Calibration certificates will be kept for every measurement device until two years after the end of the crediting period.

A. Electricity Generation Component

As the project boundary is defined as the national grid of Turkey, the baseline emissions from electricity generation activities in Turkey are calculated and monitored based on national official data. The leakage during crediting period will be negligibly small and will not be monitored, as fossil fuel consumption during construction and operation of the project activity is minimal. Hence, the monitoring plan involves the net electricity generation by the project activity;

- The two measurement instruments are not accessible by the project participant or any other party except TEİAŞ. This prevents any intervention and assures the accuracy and quality of the measurements.
- The measurement instruments in broad terms give two types of data; the total gross electricity generated and the total electricity consumed by the Project activity. The difference of these two data is the net electricity generated. Furthermore, TEİAŞ cuts a certain percentage of the generation to account for transmission losses. The net electricity generation, which is to be

[13] "Measurement and Measuring Tools Inspection Regulation", Date: 24/07/1994, Official Gazette Number: 22000

monitored and to be used for baseline emissions, is the net electricity generation, without the cut, which is the difference of gross electricity generation and self electricity consumption.

- At the end of each monitoring period, the data from the monthly meter readings will be added up to obtain the total monitoring period net electricity generation. This figure will be multiplied with the combined margin emission factor, which has been calculated ex-ante.
- The procedure will be repeated for each month. The sum of emission reductions of each month will give the total offsets achieved by the Project.

Self consumption of the project activity:

Each project activity has a certain amount of self electricity consumption. Similar to energy generation, energy consumption is also recorded and accounted for the invoicing.

Self electricity consumption of the project activity is also measured and recorded by a primary and a secondary metering devices. The TEIAS personnel comes on the first days of each succeeding month and takes the readings of the previous month in terms of gross electricity generation and self electricity consumption (beside others), for invoicing.

Following this reading, the results are transmitted on site to the TEIAS network by the TEIAS personnel electronically without any intervention. Based on this reading, a protocol form is printed out, which lists in detail the energy generation and consumption values in a similar way the PMUM web site lists them, and is then signed by the site manager and the TEIAS personnel. Therefore, self consumption values are recorded, read and treated similar to the generation values. Project participants have no access to the metering devices and the self electricity consumption data is of high quality.

Data Source:

At the first day of each month, a TEIAS personnel comes to the sites and makes a reading regarding the last period from the beginning to the end of the previous month. After making the reading from the metering device, a standard protocol showing the generation and consumption data is signed by the site manager and the TEIAS personnel. Under normal conditions, these figures are used for invoicing purposes.

Based on these monthly protocols, a detailed breakdown of generation and consumption figures is also supplied by the TEIAS Market Financial Clearing Center (PMUM) website. The project participant can access its own consumption and generation data through the web site of PMUM (http://pmum.teias.gov.tr) by using a secured ID and password. After accessing this web site, the project participant is able to call actual and historical data. These data are used by TEIAS for invoicing, and the same data source will be used for the determination of emission reductions.

TEIAS invoices according to the net electricity supply, which takes transmission line losses into account. This means that the invoiced amount of electricity is the difference of gross generation, self consumption and transmission line losses, which is determined by TEIAS every month as a certain percentage.

For emission reductions calculations, however, transmission line losses shall *not* be subtracted; therefore the invoiced amount of energy cannot be used. Instead, $\mathbf{EG_{facility,y}}$ (Annual net electricity amount fed to the grid by the project activity) will be used, which is the monitoring parameter, is the difference between the Gross Electricity Generation (GEG_y) and project activity's Self Electricity Consumption (SEC_y):

$EG_{facility,y} = GEG_y - SEC_y$

PMUM website publishes monthly GEG_y and SEC_y data in detail (with a breakdown into three daily time periods), however it does not show $EG_{facility,y}$ separately. Therefore, for each month GEG_y and SEC_y data need to be recorded and their difference has to be calculated on a monthly basis. The annual total net electricity generation is then found by summing up monthly $EG_{facility,y}$ values.

These monthly figures will be used to fill in the Net Electricity Generation Monitoring Plan spreadsheet-table. This table is provided below and is also submitted to the DOE as a separate spreadsheet-file. The monthly and annual emission reductions are calculated with this table. The scans of monthly report print-outs will be also be supplied as proof to the DOE.

The monthly invoices will also be cross-checked with the PMUM records and monthly protocols to ensure high data quality.

B. LFG Consumption for Electricity Generation

The amount of LFG combusted in the gas engines will be monitored by effectively and conservatively monitoring the methane amount supplied into each of the engine units. The actual emission reductions from the destruction of methane in the combustion units will be calculated such that the risk of overestimation is minimised, and according to the ACM0001 v.11, "Consolidated baseline and monitoring methodology for landfill gas project activities". The readings will be taken and recorded internally by compatible and proper measurement devices automatically with high data quality.

C. LFG Consumption by Flaring

An enclosed flare unit will be installed with a flame detection unit. The project emissions from flaring and emission reductions from the destruction of LFG will be monitored at this point. The readings will be taken and recorded internally by compatible and proper measurement devices automatically with high data quality.

The actual project emissions from flaring will be calculated in a conservative manner using the "Tool to determine project emissions from flaring gases containing methane"; EB28, Annex 13. Please refer to section B.7.1 and B.7.2 for details.

B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)

This monitoring methodology and baseline study application was completed on October 14th, 2009 by Yagmur Karabulut.

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SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

The starting date of a project activity is the earliest date at which either the implementation or construction or real action of a project activity begins[14]. The loan agreement is signed on 03/06/2010.. The mobilisation has started on 11/11/2010. The main equipment (generator set) order is signed on 25/11/2010. Therefore, the starting date of the project activity shall be defined as 03/06/2010.

C.1.2. Expected operational lifetime of the project activity:

The Project is designed for an operational lifetime of 15 years.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

01/06/2011

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

N/A

C.2.2.2. Length:

N/A

[14] *CDM Glossary of Terms*, Version 03

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

The Project activity has been exempted by the Ministry of Forest and Environment from the requirement to carry out an Environmental Impact Assessment. The Project is fully in line with national laws and regulations, including those involving environment, health and safety.

Current practice on the site is a combination of managed and unmanaged landfill with no methane recovery. The Project has several environmental benefits:

- It will cover the landfill area with soil, reducing the adverse visual impacts.
- The cover and an effective landfill gas collection system will reduce odour from the landfill
- It will reduce adverse impacts on human and animal health
- The LFG recovery will reduce GHG emissions and help in tackling with global warming
- It will set a good example for proper waste management
- It will minimize explosion and fire risks by decreasing gas accumulation
- It will feed clean energy to the grid, thereby reducing emissions from power generation

As one of the sustainable renewable energy generation technologies, the Project reduces the environmental impacts of the current practice on the landfill site considerably.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

N/A

SECTION E. Stakeholders' comments

The Project was acquired by the Project owner with a tender, which was organized by the Bolu Municipality. The Project and its conditions are clearly set with a mutual agreement and the Municipality is satisfied with the Project.

Following the tender, there have been several newspaper announcements about the Project that positively commented on the Project.

E.1. Brief description how comments by local stakeholders have been invited and compiled:

The Project is not required to follow an official stakeholder consultation procedure. Since an EIA report was not required by the Ministry of Environment and Forest, no official EIA meeting was organized. Instead, various unofficial meetings have been carried out between the project owner and local communities.

A meeting organized by the Project owner on 06.03.2009 has hosted several stakeholders and the opinions declared during that meeting were very positive and encouraging. There have been no negative comments from any stakeholder about the Project.

E.2. Summary of the comments received:

Stakeholders are supportive towards the Project.

E.3. Report on how due account was taken of any comments received:

Stakeholder did not raise any critical issues which would require the Project design to be revisited.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public or ODA finance used for the Project.

Annex 3

BASELINE INFORMATION

Table 22. Definition of Parameters Used

Parameter	Definition
$EF_{GRID,OM,y}$	Operating Margin Emission Factor of the grid in year y
$EM_{grid,y}$	Emissions resulting from electricity generation in year y
EG_y	Net electricity delivered to the grid in year y, excluding low cost-must run generation units
$EG_{m,y}$	Net quantity of electricity generated and delivered to the grid by power unit *m* in year *y*
$EF_{EL,m,y}$	CO_2 emission factor of power unit *m* in year *y* (tCO_2/MWh)
$EF_{CO2,m,i,y}$	Average CO_2 emission factor of fuel type *i* used in power unit *m* in year *y* (tCO_2/GJ)
$\eta_{m,y}$	Average net energy conversion efficiency of power unit *m* in year *y* (%)
m	All power units serving the grid in year *y* except low-cost / must-run power units
ER_y	Emission reductions in year y (tCO2e/yr)
PE_y	Project emissions in year y (tCO2/yr)
BE_y	Baseline emissions in year y (tCO_{2e})
$MD_{project,y}$	The amount of methane that would have been destroyed/combusted during the year, in tonnes of methane (tCH_4) in project scenario
$MD_{BL,y}$	The amount of methane that would have been destroyed/combusted during the year in the absence of the project due to regulatory and/or contractual requirement, in tonnes of methane (tCH_4)
$MD_{flared,y}$	Quantity of methane destroyed by flaring (tCH_4)
$MD_{electricity,y}$	Quantity of methane destroyed by generation of electricity (tCH_4)
$LFG_{flare,y}$	Quantity of landfill gas fed to the flare(s) during the year measured (m^3)
$w_{CH4,y}$	Average methane fraction of the landfill gas as measured during the year and expressed as a fraction (in m^3 CH_4/ m^3 LFG)
$PE_{flare,y}$	Project emissions from flaring of the residual gas stream y
$TM_{RG,h}$	Mass flow rate of methane in the residual gas in the hour h
w_{OM}	Weight of operating margin emission factor
w_{BM}	Weight of build margin emission factor
$EF_{grid,OM,y}$	Operating margin CO_2 emission factor in year y
$EF_{grid,BM,y}$	Build margin emission factor of the grid in year y
x	Year during the crediting period: x runs from the first year of the first crediting period (x = 1) to the year y for which avoided emissions are calculated (x = y)
y	Year for which methane emissions are calculated

Table 23. Capacity Additions

Year	Plant	Capacity [MW]	Fuel Type	Avg. Generation [GWh]
2004	ANKARA D.G.(BAYMİNA) GR-I-II-III	798.0	N.GAS	6500.0
2004	ENTEK GR-IV	31.1	N.GAS+NAPHTA	255.7
2004	ATATEKS 2 GM	5.6	N.GAS	45.0
2004	TANRIVERDİ 4 GM	4.7	N.GAS	38.7
2004	TEKBOY TEKSTİL 1 GM	2.2	N.GAS	16.0
2004	GÜL ENERJİ GR-II	12.5	FUEL-OIL	96.5
2004	KOMBASSAN KAĞIT GIDA VE TEKS	5.5	N.GAS	38.1
2004	AYEN OSTİM ENERJİ ÜRETİM	31.1	N.GAS	264.1
2004	BİS ENERJİ 2 GT	73.0	N.GAS	602.7
2004	ENERJİ-SA ADANA 1 BT	49.8	NAPHTA	322.9
2004	ŞAHİNLER ENERJİ 1 GM	3.2	N.GAS	22.2
2004	BESLER GR-2, BT (5,2+7,5)	12.7	N.GAS	97.7
2004	ÇELİK ENERJİ ÜR.ŞTİ. 2 GM	2.4	N.GAS	18.6
2004	KOMBASSAN KAĞ. MATBAA GIDA	5.5	N.GAS	35.7
2004	AYEN OSTİM ENERJİ ÜRETİM(BT)	9.9	N.GAS	84.0
2004	HABAŞ ALİAĞA GRUP I-II	89.2	N.GAS	713.9
2004	STANDART PROFİL 3 GM	6.7	N.GAS	49.2
2004	KARKEY-II 3+3 DGM	54.3	FUEL-OIL	369.7
2004	ALTINMARKA GIDA GR I-II-III	3.6	N.GAS	28.8
2004	ERE(BİR KAPILI HES) GRUP-I	48.5	RUN OF RIVER	170.6
2004	ELTA ELK(DODURGA) GR-I-II-III-IV	4.1	RUN OF RIVER	12.3
2004	İSKUR TEKSTİL(SÜLEYMANLI) GR I-II	4.6	RUN OF RIVER	17.9
2004	BEREKET EN.(Feslek Hes) Gr-1-2	9.5	RUN OF RIVER	41.0
2005	ÇAN GR I	160.0	LIGNITE	1040.0
2005	ÇAN GR II	160.0	LIGNITE	1040.0
2005	ELBİSTAN-B GR I	360.0	LIGNITE	2340.0
2005	AKÇA ENERJİ GR-III	8.7	N.GAS+NAPHTHA	65.4
2005	AYKA TEKSTİL GR-I	5.5	N.GAS	40.0
2005	BAYDEMİRLER GR IV-V-VI	6.2	N.GAS	51.4
2005	BOSEN GR-III	50.0	N.GAS	350.0
2005	ÇUMRA ŞEKER	16.0	N.GAS+LIGNITE	40.0
2005	ETİ MAD.(BAN.ASİT)GR-I	11.5	RENEW.+WASTES	85.0
2005	EVYAP GR I-II	5.1	N.GAS	30.0
2005	GRANİSER GRANİT GR-I	5.5	N.GAS	42.0
2005	HABAŞ ALİAĞA GR III	47.7	N.GAS	381.6
2005	HABAŞ ALİAĞA GR IV	47.7	N.GAS	381.6
2005	HABAŞ ALİAĞA GR-V	24.6	N.GAS	196.8
2005	HAYAT KAĞIT GR-I	7.5	N.GAS	56.0
2005	İÇDAŞ ÇELİK GR-I	135.0	IMPORTED COAL	1080.0
2005	KAHRAMANMARAŞ KAĞIT GR-I	6.0	IMPORTED COAL	45.0
2005	KORUMA KLOR GR I-II-III	9.6	N.GAS	77.0
2005	KÜÇÜKÇALIK TEKSTİL GR I-II-III-IV	8.0	N.GAS	64.0
2005	MERCEDES BENZ TURK GR I-II-III-IV	8.3	N.GAS	68.0
2005	MODERN ENERJİ GR-III	8.4	N.GAS	62.9

2005	MODERN ENERJİ GR-II	6.7	N.GAS+LPG	50.4
2005	MOSB GR I-II-III-IV-V-VI-VII	84.8	N.GAS	434.0
2005	ORS RULMAN	12.4	N.GAS	99.4
2005	PAK GIDA(Kemalpaşa) GR-I	5.7	N.GAS	45.0
2005	TEZCAN GALVANİZ GR I-II	3.7	N.GAS	29.0
2005	YONGAPAN(KAST.ENTG) GR-II	5.2	N.GAS	32.7
2005	ZEYNEP GİYİM SAN. GR-I	1.2	N.GAS	9.0
2005	AK ENERJİ(K.paşa) GR- III	40.0	N.GAS	256.9
2005	AK ENERJİ(K.paşa) GR I-II	87.2	N.GAS	560.1
2005	ALTEK ALARKO GR I-II	60.1	N.GAS	420.0
2005	BİS ENERJİ GR VII	43.7	N.GAS	360.8
2005	CAN ENERJİ GR-I	3.9	N.GAS	28.0
2005	ÇEBİ ENERJİ BT	21.0	N.GAS	164.9
2005	ÇEBİ ENERJİ GT	43.4	N.GAS	340.1
2005	ENTEK ELK.A.Ş.KOÇ ÜNİ.GR I-II	2.3	N.GAS	19.0
2005	KAREGE GR IV-V	18.1	N.GAS	141.9
2005	KARKEY(SİLOPİ-4) GR-IV	6.2	F.OIL	47.2
2005	KARKEY(SİLOPİ-4) GR-V	6.8	F.OIL	51.9
2005	METEM ENERJİ(Hacışıramat) GR I-II	7.8	N.GAS	58.0
2005	METEM ENERJİ(Peliklik) GR I-II-III	11.7	N.GAS	89.0
2005	NOREN ENERJİ GR-I	8.7	N.GAS	70.0
2005	NUH ENERJİ-2 GR I	47.0	N.GAS	319.7
2005	ZORLU ENERJİ KAYSERİ GR-I-II-III	149.9	N.GAS	1144.1
2005	ZORLU ENERJİ KAYSERİ GR-IV	38.6	N.GAS	294.9
2005	ZORLU ENERJİ YALOVA GR I-II	15.9	N.GAS	122.0
2005	İÇTAŞ ENERJİ(Yukarı Mercan) GR I-II	14.2	RUN OF RIVER	44.0
2005	MURATLI GR I-II	115.0	DAM	444.0
2005	BEREKET EN.(DALAMAN) GR XIII-XIV-XV	7.5	RUN OF RIVER	35.8
2005	YAMULA GRUP I-II	100.0	DAM	422.0
2005	SUNJÜT(RES) GR I-II	1.2	WIND	2.4
2006	EKOTEN TEKSTİL GR-I	1.9	N.GAS	14.0
2006	ERAK GİYİM GR-I	1.4	N.GAS	10.0
2006	ALARKO ALTEK GR-III	21.9	N.GAS	158.3
2006	AYDIN ÖRME GR-I	7.5	N.GAS	60.0
2006	NUH ENERJİ-2 GR II	26.1	N.GAS	180.1
2006	MARMARA ELEKTRİK (Çorlu) GR I	8.7	N.GAS	63.0
2006	MARMARA PAMUK (Çorlu) GR I	8.7	N.GAS	63.0
2006	ENTEK (Köseköy) GR IV	47.6	N.GAS	378.2
2006	ELSE TEKSTİL (Çorlu) GR I - II	3.2	N.GAS	25.0
2006	SÖNMEZ ELEKTRİK (Çorlu) GR I - II	17.5	N.GAS	126.0
2006	MENDERES ELEKTRİK GR I	8.0	GEOTHERMAL	56.0
2006	KASTAMONU ENTEGRE (Balıkesir) GR I	7.5	N.GAS	54.0
2006	BOZ ENERJİ GR I	8.7	N.GAS	70.0
2006	ADANA ATIK SU ARITMA TESİSİ	0.8	BIOGAS	6.0
2006	AMYLUM NİŞASTA (ADANA)	14.3	N.GAS	34.0
2006	ŞIK MAKAS (Çorlu) GR I	1.6	N.GAS	13.0
2006	ELBİSTAN B GR III	360.0	LIGNITE	2340.0

2006	ANTALYA ENERJİ GR I - II - III - IV	34.9	N.GAS	245.0
2006	HAYAT TEM. VE SAĞLIK GR I - II	15.0	N.GAS	108.0
2006	EKOLOJİK EN. (Kemerburgaz) GR I	1.0	LANDFILL GAS	6.0
2006	EROĞLU GİYİM (Çorlu) GR I	1.2	N.GAS	9.0
2006	CAM İŞ ELEKTRİK (Mersin) GR I	126.1	N.GAS	1008.0
2006	ELBİSTAN B GR II	360.0	LIGNITE	2340.0
2006	YILDIZ ENT. AĞAÇ (Kocaeli) GR I	6.2	N.GAS	40.0
2006	ÇERKEZKÖY ENERJİ GR I	49.2	N.GAS	390.0
2006	ENTEK (Köseköy) GR V	37.0	N.GAS	293.9
2006	ELBİSTAN B GR IV	360.0	LIGNITE	2340.0
2006	ÇIRAĞAN SARAYI GR I	1.3	N.GAS	11.0
2006	AKMAYA (Lüleburgaz) GR I	6.9	N.GAS	50.0
2006	BURGAZ (Lüleburgaz) GR I	6.9	N.GAS	54.0
2006	SEYHAN I-II	0.3	HYDRO	1.7
2006	ŞANLIURFA GR I-II	51.8	HYDRO	124.0
2006	BEREKET ENERJİ GÖKYAR HES 3 Grup	11.6	HYDRO	43.3
2006	MOLU EN. Zamantı Bahçelik GR I - II	4.2	HYDRO	16.7
2006	SU ENERJİ (Balıkesir) GR I - II	4.6	HYDRO	20.7
2006	BEREKET EN.(Mentaş Reg) GR I - II	26.6	HYDRO	108.7
2006	EKİN (Başaran Hes) (Nazilli)	0.6	HYDRO	4.5
2006	ERE(Sugözü rg. Kızıldüz hes) GR I - II	15.4	HYDRO	31.6
2006	ERE(AKSU REG.ve ŞAHMALLAR HES) GR I-II	14.0	HYDRO	26.7
2006	BEREKET EN.(Mentaş Reg) GR III	13.3	HYDRO	54.4
2007	HABAŞ (Aliağa-ilave)	9.1	N.GAS	72.8
2007	MODERN ENERJİ	5.2	N.GAS	38.7
2007	ARENKO	0.7	N.GAS	5.6
2007	ALTINMARKA GIDA	0.1	N.GAS	0.8
2007	TEKBOY ENERJİ	0.1	N.GAS	0.7
2007	VELSAN AKRİLİK	0.1	N.GAS	0.7
2007	Acıbadem Sağlık Hiz.ve Tic.A.Ş(Kadıköy Hast.)(İstanbul/Kadıköy)	0.5	N.GAS	4.0
2007	Acıbadem Sağlık Hiz.ve Tic.A.Ş(Kozyatağı Hast.)(İstanbul/Kadıköy)	0.6	N.GAS	5.0
2007	Acıbadem Sağlık Hiz.ve Tic.A.Ş(Nilüfer/BURSA)	1.3	N.GAS	11.0
2007	AKATEKS Tekstil Sanayi ve Ticaret A.Ş.	1.8	N.GAS	14.0
2007	FLOKSER TEKSTİL SAN.AŞ.(Çatalça/istanbul)(Poliser Tesisi)	2.1	N.GAS	17.0
2007	FLOKSER TEKSTİL SAN.AŞ.(Çatalça/istanbul)(Süetser Tesisi)	2.1	N.GAS	17.0
2007	FRİTOLAY GIDA SAN.VE TİC. AŞ.	0.5	N.GAS	4.0
2007	KIVANÇ TEKSTİL SAN.ve TİC.A.Ş.	3.9	N.GAS	33.0
2007	KİL-SAN KİL SAN.VE TİC. A.Ş	3.2	N.GAS	25.0
2007	SÜPERBOY BOYA SAN.ve Tic.Ltd.Şti.(Büyükçekmece/İstanbul)	1	N.GAS	8.0
2007	SWİSS OTEL(Anadolu Japan Turizm A.Ş (İstanbul)	1.6	N.GAS	11.0
2007	TAV Esenboğa Yatırım Yapım ve İşetme AŞ./ANKARA	3.9	N.GAS	33.0
2007	NUH ENERJİ-2(Nuh Çim.)	73	N.GAS	514.0
2007	AKTEKS	0.8	FUEL-OIL	5.6

2007	UŞAK ŞEKER (NURİ ŞEKER)	1.7	LIGNITE	11.1
2007	BOĞAZLIYAN ŞEKER	16.4	D.OIL & N.GAS	131.2
2007	KARTONSAN	5.0	D.OIL & N.GAS	40.0
2007	ESKİŞEHİR END.ENERJİ	3.5	D.OIL & N.GAS	26.8
2007	ESKİŞEHİR ŞEKER (KAZIM TAŞKENT)	2.9	D.OIL & N.GAS	23.2
2007	İGSAŞ	2.2	D.OIL & N.GAS	15.2
2007	DESA	0.7	D.OIL & N.GAS	4.6
2007	DENTAŞ	0.3	D.OIL & N.GAS	2.3
2007	SÜPER FİLMCİLİK	0.1	D.OIL & N.GAS	0.8
2007	ATAER ENERJİ	0.1	D.OIL & N.GAS	0.6
2007	BİL ENERJİ	0.1	D.OIL & N.GAS	0.7
2007	BİS Enerji Üretim AŞ.(Bursa)(İlave)	43	N.GAS	354.8
2007	Aliağa Çakmaktepe Enerji A.Ş.(Aliağa/İZMİR)	34.8	N.GAS	278.0
2007	BİS Enerji Üretim AŞ.(Bursa)(İlave)	48	N.GAS	396.1
2007	BOSEN ENERJİ ELEKTRİK AŞ.	142.8	N.GAS	1071.0
2007	SAYENERJİ ELEKTRİK ÜRETİM AŞ. (Kayseri/OSB)	5.9	N.GAS	47.0
2007	T ENERJİ ÜRETİM AŞ.(İSTANBUL)	1.6	N.GAS	13.0
2007	ZORLU EN.Kayseri (İlave 1 GT)	7.2	N.GAS	55.0
2007	SİİRT	25.6	FUEL-OIL	190.0
2007	Mardin Kızıltepe	34.1	FUEL-OIL	250.0
2007	KAREN	24.3	FUEL-OIL	180.0
2007	İDİL 2 (PS3 A- 2)	24.4	FUEL-OIL	180.0
2007	YPM Ener.Yat.AŞ.(Altıntepe Hidro.)(Sivas/Suşehir)	4	HYDRO	18.0
2007	YPM Ener.Yat.AŞ.(Beypınar Hidro.)(Sivas/Suşehir)	3.6	HYDRO	18.0
2007	YPM Ener.Yat.AŞ.(Konak Hidro.)(Sivas/Suşehir)	4	HYDRO	19.0
2007	KURTEKS Tekstil A.Ş./Kahramanmaraş(KARASU HES-Andırın)	2.4	HYDRO	19.0
2007	İSKUR TEKSTİL (SÜLEYMANLI HES)	4.6	HYDRO	18.0
2007	ÖZGÜR ELK.AŞ.(K.MARAŞ)(Tahta)	6.3	HYDRO	27.2
2007	ÖZGÜR ELK.AŞ.(K.MARAŞ)(Tahta)(İlave)	6.3	HYDRO	27.2
2008	MB ŞEKER NİŞASTA SAN. A.Ş. (Sultanhanı)	8.8	N. GAS	60.0
2008	AKSA ENERJİ (Antalya)	183.8	N. GAS	1290.0
2008	AKSA ENERJİ (Manisa)	52.38	N. GAS	370.0
2008	ANTALYA ENERJİ (İlave)	17.46	N. GAS	122.3
2008	ATAÇ İNŞAAT SAN. A.S.B. (ANTALYA)	5.4	N.GAS	37.0
2008	BAHÇIVAN GIDA(LÜLEBURGAZ)	1.165	N.GAS	8.0
2008	CAN ENERJİ (Çorlu-TEKİRDAĞ)(İlave)	52.38	N.GAS	304.2
2008	FOUR SEASONS OTEL (ATİK PASHA TUR.A.Ş.)	1.165	N.GAS	7.0
2008	FRİTOLAY GIDA SAN. VE TİC. A.Ş. (İlave)	0.06	N.GAS	4.0
2008	KARKEY (SİLOPİ-5)(154kV)(İlave)	14.78	FUEL-OIL	103.2
2008	MELİKE TEKSTİL (GAZİANTEP)	1.584	N.GAS	11.0
2008	MİSİS APRE TEKSTİL BOYA EN. SAN.	2	N.GAS	14.0
2008	MODERN ENERJİ (LÜLEBURGAZ)	13.4	N.GAS	94.1
2008	ORTADOĞU ENERJİ (ODA YERİ)(Eyüp-İst)	2.83	LANDFILL GAS	22.0
2008	POLAT TURZ. (POLAT RENAISSANCE İST.OT.)	1.6	N.GAS	11.0
2008	SARAYKÖY JEOTERMAL(DENİZLİ)	6.85	GEOTHERMAL	50.0

2008	YILDIZ SUNTA (Uzunçiftlik-Köseköy)(Düzeltme)	22.63	N.GAS	146.5
2008	SÖNMEZ Elektrik (İlave)	8.73	N.GAS	67.3
2008	AKKÖY ENERJİ (AKKÖY I HES)	101.94	HYDRO	408.0
2008	ALP ELEKTRİK (TINAZTEPE) ANTALYA	7.689	HYDRO	29.0
2008	CANSU ELEKTRİK (Murgul/ARTVİN)	9.18	HYDRO	47.0
2008	DAREN HES ELKT. (SEYRANTEPE BARAJI VE HES)	49.7	HYDRO	182.0
2008	DEĞİRMENÜSTÜ EN. (KAHRAMANMARAŞ)	25.7	HYDRO	69.0
2008	GÖZEDE HES (TEMSA ELEKTRİK) BURSA	2.4	HYDRO	10.0
2008	H.G.M. ENERJİ (KEKLİCEK HES) (Yeşilyurt)	8.674	HYDRO	18.0
2008	HİDRO KNT.(YUKARI MANAHOZ REG.VE HES)	22.44	HYDRO	79.0
2008	İÇ-EN ELK.(ÇALKIŞLA REGÜLATÖRÜ VE HES)	7.66	HYDRO	18.0
2008	KALEN ENERJİ (KALEN II REGÜLAT. VE HES)	15.65	HYDRO	50.0
2008	MARAŞ ENERJİ (FIRNIS REGÜLATÖRÜ VE HES)	7.22	HYDRO	36.0
2008	SARMAŞIK I HES (FETAŞ FETHİYE ENERJİ)	21.04	HYDRO	96.0
2008	SARMAŞIK II HES (FETAŞ FETHİYE ENERJİ)	21.58	HYDRO	108.0
2008	TORUL	105.6	HYDRO	322.0
2008	YEŞİL ENERJİ ELEKTRİK (TAYFUN HES)	0.8	HYDRO	5.0
Total		**6,394.3**		**42,929.0**

Table 24. NCVs and Emission Factors of Fuels

NCV Calculations [TJ/kt or TJ/mil m^3]	2004	2005	2006	2007	2008	Emission Factor, [tCO_2/TJ]
Hard Coal	15.1	13.6	18.1	18.2	17.9	90.8
Imported Coal	25.5	24.7	24.5	25.0	24.9	90.8
Lignite	7.6	5.9	6.9	6.9	6.8	90.9
Fuel Oil	39.9	40.2	40.2	39.8	39.7	75.5
Diesel Oil	42.4	42.8	42.7	43.1	42.3	72.6
Lpg	45.9	46.0	0.0	0.0	1.0	61.6
Naphta	44.0	44.3	43.9	43.2	44.6	69.3
Natural Gas	36.9	37.3	37.0	36.7	36.6	54.3

Table 25. CO_2 Emissions Breakdown by Fuel Type

CO_2 Emissions, $ktCO_2$	2004	2005	2006	2007	2008
Hard Coal	1,860	2,155	3,758	4,091	3,908
Imported Coal	7,388	7,858	7,424	8,080	8,747
Lignite	23,207	26,057	31,921	38,154	41,161
Fuel Oil	7,242	6,085	5,297	6,771	6,510
Diesel Oil	90	88	190	157	403
Lpg	36	37	0	0	0
Naphta	637	260	41	34	33
Natural Gas	26,687	31,886	34,212	40,811	42,952
Total Calculated	67,145	74,426	82,844	98,099	103,714
Official data supplied to UNFCCC	70,499	**83,680**	**85,312**	**100,662**	**101,473**

Table 26. Electricity Generation of Selected Recent Capacity Additions by Fuel Type

Capacity Additions	2004	2005	2006	2007	2008	Total	Indicative Efficiency
Coal	0.0	1125.0	0.0	0.0	0.0	1125.0	40.0%
Lignite	0.0	4420.0	7020.0	11.1	0.0	11451.1	40.0%
Fuel Oil	466.2	99.1	0.0	806.4	103.2	1474.9	46.0%
Diesel oil	0.0	0.0	0.0	0.0	0.0	0.0	46.0%
LPG	0.0	0.0	0.0	0.0	0.0	0.0	60.0%
Naphtha & Asphaltite	322.9	0.0	0.0	0.6	0.0	323.5	46.0%
Natural Gas	8810.4	6995.4	3457.4	3274.2	2546.5	25083.9	60.0%
Renewables and wastes	0.0	85.0	12.0	0.0	22.0	119.0	N/A
Hydro	241.8	945.8	432.3	146.4	1477.0	3243.3	N/A
Geothermal & Wind	0.0	2.4	56.0	0.0	50.0	108.4	N/A
Total	**9,841.4**	**13,672.7**	**10,977.7**	**4,238.6**	**4,198.7**	**42,929.0**	

Annex 4

MONITORING INFORMATION

A. Electricity Generation Component

The switchgear station, where the measurement instruments are read periodically by TEİAŞ, is only accessible to trained TEİAŞ staff. On the first days of each successive month, the TEİAŞ staff performs the reading, upon which the invoicing will be based.

There will be two measurement instruments monitoring the generated electricity continuously. Furthermore, a SCADA system on the Project activity site will monitor and store various data including the electricity generation of each wind turbine separately. The project participant is able to monitor the electricity generation data read by the SCADA system as well as the two measurement instruments from a distance; however it has no control over or access to the measurement devices and cannot perform any type of maintenance or calibration.

Energy generation and consumption of the Project is measured and recorded with a single primary metering device and another secondary metering device for high data quality. A TEIAŞ personnel comes each month to the Project site and connects to the primary and secondary metering devices using his own equipment, without any interference from the project participant. This TEIAS personnel takes readings from both devices and compares them. If the difference of both devices is higher than 0.002, then technical precautions described in Section B.7.2. are taken by TEIAS to ensure data quality. Under normal conditions, the digital readings are uploaded by the TEIAS personnel to TEIAS on site and a print-out of the preceding month's generation and consumption summary is signed by both the site engineer and the TEIAS personnel.

The net electricity generated and delivered to the grid can be monitored from TEİAŞ invoices, from the PMUM -Market Financial Settlement Centre- (MFSC) website[15] or the SCADA system. To ensure high quality data, PMUM web site data will be used to calculate the net electricity generation.

A spreadsheet will be prepared and filled in with PMUM data to calculate the emission reductions.

Responsibility:
The methodology requires monitoring of net electricity supply of the Project. Archiving the daily power generation reports, performance report and monthly meter reading is handled by project proponent on regular basis. The data collection on daily basis is done by project O&M staff, who are responsible for preventive maintenance, handling emergency situations and improvement measures under the overall responsibility of project manager on site.

Data Quality:

The generation and consumption data will be used for invoicing purposes. The data is of high quality, because the monthly reports are signed both by the project proponent and by TEİAŞ, the public transmission line operator. Measuring devices will have accuracy better than UNFCCC requirements, thus fulfilling quality conditions.

[15] http://www.teias.gov.tr/mali/maliuz.htm

Monitored Data:

Net Electricity Generation of the Project = Gross Generation of the Project – Consumption of the Project

Gross Generation of the Project and Consumption of the Project will be monitored and recorded to calculate Net Electricity Generation of the Project.

Storage of Data:

Data involving consumption and generation will be kept by PMUM, the market financial settlement centre and users (project proponents included) can access its website with its unique ID and password to be able to see these data. Storage will be done by PMUM for an unlimited period of time, which ensures UNFCCC criteria.

Calibration of Measuring Devices:

There are two measuring devices, one main and one back-up device to prevent any potential errors which may result from device failures. If two devices show a significant bias, the failing device will be dismantled by TEİAŞ personnel and calibrated by TEİAŞ to ensure high quality. Project proponents have no access to measuring devices in any way and both devices are sealed.

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